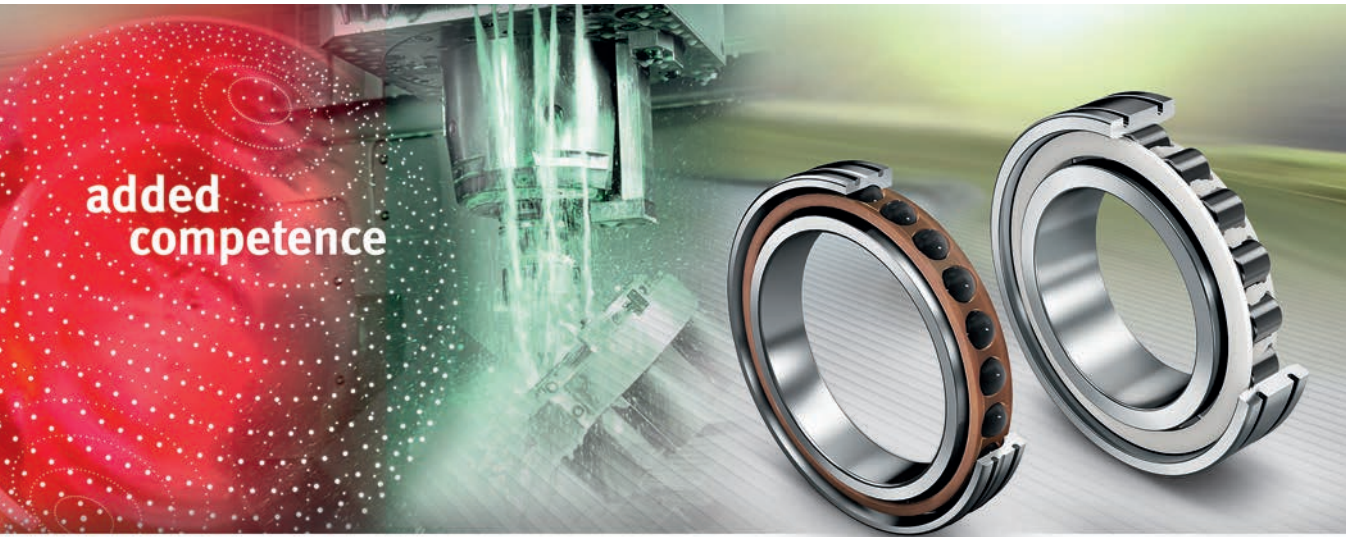




**FAG**



# Super Precision Bearings

Spindle bearings  
Super precision cylindrical roller bearings  
Axial angular contact ball bearings

**SCHAEFFLER**





# Super Precision Bearings

Spindle bearings

Super precision cylindrical roller bearings

Axial angular contact ball bearings

All data have been prepared with a great deal of care and checked for their accuracy. However, no liability can be assumed for any incorrect or incomplete data. We reserve the right to make technical modifications.

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New edition

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## Preface

### **Market and technology leadership**

With its forward-looking bearing solutions for main spindles, feed spindles, rotary tables and linear axes in machine tools, Schaeffler with its brands INA and FAG has been at the forefront of the world market for decades.

### **Precision and operational security**

FAG super precision bearings for main spindles stand for very high precision and absolute operational security. Innovative FAG spindle bearing solutions are continually raising standards in relation to speeds, accuracy and rating life. For the main spindle system and the overall machine tool system to be successful, however, bearing components alone are no longer sufficient as a guarantee. Significant increases in performance and the creation of unique selling propositions for the customer are now achieved when the bearing manufacturer offers advice and carries out development work on the basis of wide-ranging system knowledge as well as being able to provide support through a range of service functions. It is through close partnership with the manufacturers of spindles and machine tools and through shared knowledge, founded on experience, of the requirements of end users and their customers that the potential exists for achieving a leading role in the market.

### **“added competence” for production machinery**

The competence in application engineering, advisory work and production technology built up by Schaeffler over more than 130 years is always provided, together with one of the largest product portfolios worldwide, to our customers to enhance their own know-how. In return, the Schaeffler Group benefits from close proximity to the actual application and from intensive contact with its partners. This mindset of co-operative partnership in order to achieve “higher speed, better accuracy, longer life and more cost-effectiveness” in both the subsystem and the complete system is described by the Schaeffler Business Unit Production Machinery as “added competence”.

### **Optimised customer benefit**

The dominant objective of this approach is optimum benefit for the customer. In the case of main spindle bearings too, this standard extends well beyond the manufacture of the best products. At the focus is the point of use and the end user together with all his requirements. For all the areas of the company involved in the manufacture of FAG super precision bearings, this creates requirements for top quality and technological leadership, maximum proximity to the customer and the very highest cost-effectiveness for the specific application.

The integration of important functions such as sealing, lubrication, location, damping, anti-corrosion protection and many others leads to a reduction in the number of interfaces as well as increased operational security, freedom from maintenance, increased energy efficiency, time advantages in the market and cost savings. Customer benefit is also increased by the provision of fundamental research, calculation programs, mounting aids and training through a close-knit network of sales and production facilities. The reliable, timely and local presence of Schaeffler employees secures our greatest resource: our “personal contact” with you, our partners.

# Preface



*Figure 1*  
The very highest precision and  
purity in production ...



*Figure 2*  
... in the mounting of bearings



*Figure 3*  
... in inspection



*Figure 4*  
... in the results of production

# Preface

## **Solutions for the main spindle**

The starting point and objective of all activities in the company is proximity to and benefit for the customer. Precise knowledge of specific application requirements and processes is the decisive factor in selection of the technically optimum product that also incurs the lowest system costs. This may be sourced from the fully developed standard range of spindle bearings, which is unsurpassed in its scope worldwide. Equally, it may lie in an individual, application-specific solution that is provided rapidly and reliably by the Schaeffler Group.

FAG super precision bearings set standards in machine tools, in the textile industry, in woodworking machinery and wherever extreme demands are placed on reliability, running accuracy and high speeds, individually or in combination. Due to the comprehensive product range, it is possible to achieve optimum designs for all bearing positions and applications.

## **Technical and economic leadership**

Building on principles developed in the research facilities of the Schaeffler Group and close contact with customers, further development is carried out continually on existing products and the product range is steadily expanded. FAG super precision bearings are always a combination of the technical solution to a bearing application with the economic solution. This is clear from the complete consideration of the bearing arrangement system in calculation, simulation and design as well as in distribution, mounting and service.

Schaeffler Technologies also offers proven calculation and simulation tools, for in-house use or as a service, as well as comprehensive training and advice events.

## **FAG accuracy P4S**

The accuracy of bearings initially appears to be sufficiently well described in the DIN, ISO and ABEC accuracy classes. For FAG super precision bearings, however, this is not enough. Where it is necessary to achieve tolerances to P4 or better, the performance characteristics involved are not described in the reference works.

FAG super precision angular contact ball bearings fulfil the standard P4S. Super precision cylindrical roller bearings and axial angular contact ball bearings (2344) are manufactured in accordance with the accuracy standards SP or UP that are matched to machine tool requirements.

**About this catalogue**

Catalogue SP1 gives an overview of the FAG product range of super precision bearing arrangements as well as the most important rules covering bearing selection, bearing arrangement design and mounting.

One function of the catalogue is to present the product range of FAG super precision bearings for main spindles. In addition, it is also intended as a technical compendium for the selection and design of bearing arrangements using super precision bearings.

This catalogue brings together the most important technical principles for the designer. It thus gives a transparent representation of the FAG portfolio covering all components, competences and services.

# Contents

|   | Page |
|---|------|
| Product index .....                               | 9    |
| Technical principles .....                        | 14   |
| Spindle bearings .....                            | 118  |
| Super precision cylindrical roller bearings ..... | 190  |
| Axial angular contact ball bearings.....          | 220  |
| Customer solutions.....                           | 234  |
| Appendix.....                                     | 245  |
| Checklists and order forms                        |      |
| Addresses   |      |

# Product index

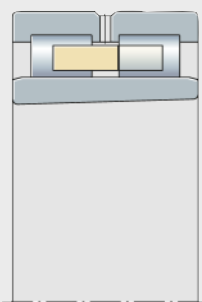
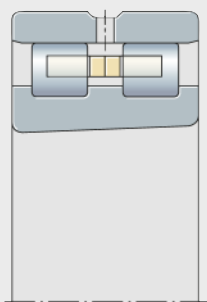
|   | Page |
|---|------|
| <b>2344</b>   Axial angular contact ball bearings, double direction,<br>mounting on small taper side.....   | 222  |
| <b>BAX</b>   Axial bearings BAX.....  | 222  |
| <b>B70</b>   Standard spindle bearings,<br>steel balls, medium series .....   | 120  |
| <b>B719</b>   Standard spindle bearings,<br>steel balls, light series .....   | 120  |
| <b>B72</b>   Standard spindle bearings,<br>steel balls, heavy series.....   | 120  |
| <b>HC70</b>   Hybrid spindle bearings with small balls,<br>ceramic balls, medium series.....  | 120  |
| <b>HC719</b>   Hybrid spindle bearings with small balls,<br>ceramic balls, light series .....   | 120  |
| <b>HCB70</b>   Hybrid standard spindle bearings,<br>ceramic balls, medium series.....   | 120  |
| <b>HCB719</b>   Hybrid standard spindle bearings,<br>ceramic balls, light series .....  | 120  |
| <b>HCB72</b>   Hybrid standard spindle bearings,<br>ceramic balls, heavy series .....   | 120  |
| <b>HCN10</b>   High speed cylindrical roller bearings,<br>single row, ceramic rollers, ribs on inner ring,<br>ribless outer ring, medium series ..... | 192  |
| <b>HCRS70</b>   Hybrid high speed spindle bearings,<br>ceramic balls, medium series.....  | 120  |
| <b>HCRS719</b>   Hybrid high speed spindle bearings,<br>ceramic balls, light series .....   | 120  |
| <b>HS70</b>   Spindle bearings with small balls,<br>steel balls, medium series .....  | 120  |
| <b>HS719</b>   Spindle bearings with small balls,<br>steel balls, light series .....  | 120  |

# Product index

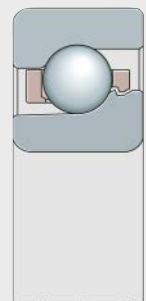
|   | Page |
|---|------|
| <b>N10</b>   Cylindrical roller bearings, single row, ribs on inner ring,<br>ribless outer ring, medium series .....  | 192  |
| <b>N19</b>   Cylindrical roller bearings, single row, ribs on inner ring,<br>ribless outer ring, light series .....   | 192  |
| <b>NN30</b>   Cylindrical roller bearings, double row, ribs on inner ring,<br>ribless outer ring, medium series ..... | 192  |
| <b>NNU49</b>   Cylindrical roller bearings, double row, ribs on outer ring,<br>ribless inner ring, light series ..... | 192  |
| <b>RS70</b>   High speed spindle bearings,<br>steel balls, medium series .....  | 120  |
| <b>RS719</b>   High speed spindle bearings,<br>steel balls, light series .....  | 120  |
| <b>XC70</b>   Hybrid spindle bearings with small balls,<br>Cronidur, ceramic balls, medium series .....               | 120  |
| <b>XC719</b>   Hybrid spindle bearings with small balls,<br>Cronidur, ceramic balls, light series.....                | 120  |



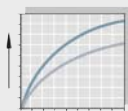




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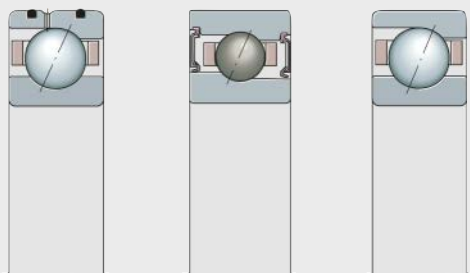


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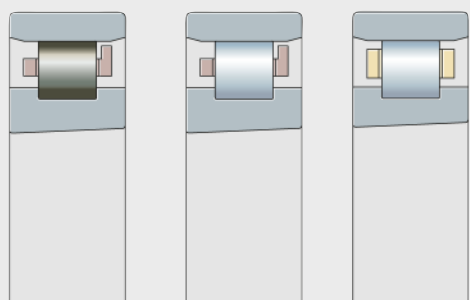
## Technical principles



00016A70

### Spindle bearings

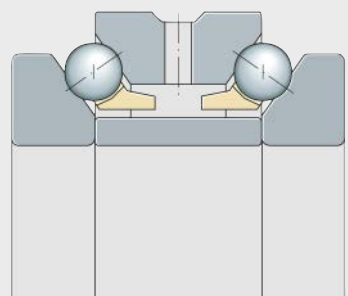
- Universal bearings
  - Single row
  - Contact angle: 15°, 20°, 25°
  - With large or small balls
  - Rolling elements: rolling bearing steel or ceramic
  - Rings: rolling bearing steel or Cronidur
  - Direct Lube



00016A71

### Super precision cylindrical roller bearings

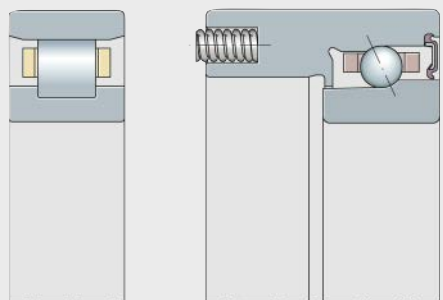
- Single row
- Double row
- Rolling elements: rolling bearing steel or ceramic
- Cages: brass, polyamide or PEEK
- Standard or thermally robust
- Full or half number of rollers



00016A72

### Axial angular contact ball bearings 2344, axial bearings BAX

- Double direction
- Contact angle: 30°, 40°, 60°
- Rolling elements: rolling bearing steel or ceramic
- Rings: rolling bearing steel
- Cages: brass, laminated fabric



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### Customer solutions

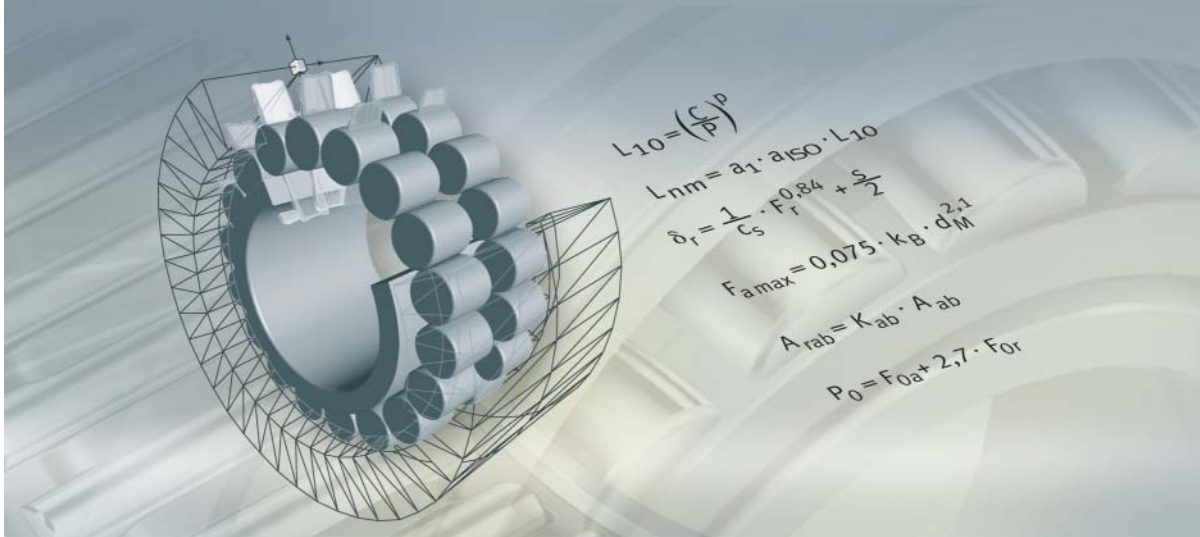
- Spindle bearings
  - Spring preloaded non-locating bearing unit
  - Thin dense chromium coating on outside diameter
  - Open bearings supplied greased
- Cylindrical roller bearings
  - Bearings with cylindrical bore and special radial internal clearance

## Appendix

- Checklists and order forms
- Addresses



**FAG**



## Technical principles

Components and materials

Tolerances

Speeds

Rigidity

Load carrying capacity and operating life

Lubrication

Operating temperature

Design and examples of bearing arrangements

Mounting

Bearing monitoring



# Technical principles

|  | Page   |
|--|--|
| <b>Components and materials</b>  | Steels for bearing rings and rolling elements..... 17  |
|  | Standard rolling bearing steel 100Cr6 ..... 17   |
|  | High performance steel Cronidur 30 ..... 17  |
|  | Materials for rolling elements ..... 18  |
|  | Cage function and materials for cages..... 19  |
|  | Angular contact ball bearings ..... 19   |
|  | Cylindrical roller bearings and double direction<br>axial angular contact ball bearings ..... 19 |
|  | Seal materials ..... 21  |
|  | Coatings..... 21   |
|  | <b>Tolerances</b>  |
| Tolerances of super precision bearings ..... 30  |  |
| Dimensional, geometrical and positional tolerances<br>of spindle bearings and BAX..... 30                    |  |
| Dimensional, geometrical and positional tolerances<br>of super precision cylindrical roller bearings..... 34 |  |
| Dimensional, geometrical and positional tolerances<br>of axial angular contact ball bearings (2344) ..... 41 |  |
| Chamfer dimensions ..... 43  |  |
| Machining tolerances of adjacent parts ..... 46  |  |
| Spindle bearings..... 56   |  |
| Super precision cylindrical roller bearings and<br>axial bearings (2344) ..... 58                            |  |
| <b>Speeds</b>  |  |
|  | Super precision cylindrical roller bearings ..... 61   |
|  | Axial angular contact ball bearings ..... 61   |
| <b>Rigidity</b>  | Axial rigidity ..... 62  |
|  | Lift-off force..... 63   |
|  | Radial rigidity ..... 63   |
| <b>Load carrying capacity and operating life</b>   | Operating life of super precision bearings ..... 64  |
|  | Fatigue strength ..... 64  |
|  | Static load safety factor..... 65  |
|  | Equivalent static bearing load ..... 65  |
| <b>Lubrication</b>   | Principles ..... 68  |
|  | Selection of the type of lubrication ..... 68  |
|  | Optimised lubricants ..... 68  |
|  | Lubricant viscosity ..... 69   |
|  | Grease lubrication ..... 70  |
|  | Greases with special suitability ..... 71  |
|  | Grease quantities..... 72  |
|  | Grease operating life ..... 75   |
|  | Grease distribution cycle..... 76  |
|  | Oil lubrication ..... 77   |
| Lubrication methods ..... 77   |  |
| Requisite cleanliness ..... 77   |  |
| <b>Operating temperature</b>   | Spindle bearings ..... 80  |
|  | Super precision cylindrical roller bearings ..... 80   |
|  | Axial angular contact ball bearings ..... 80   |

# Technical principles

|   | Page  |                             |
|---|---|-----------------------------|
| <b>Design and examples<br/>of bearing arrangements</b>        | Design and applications ..... 81                                      |                             |
|   | Preload ..... 81  |                             |
|   | Rigidity ..... 82   |                             |
|   | Bearing contact angle..... 83   |                             |
|   | Bearing selection according to ball size and material ..... 83        |                             |
|   | Selection of the optimum bearing spacing ..... 84                     |                             |
|   | Sealing ..... 84  |                             |
|   | Stages in bearing arrangement design ..... 85                         |                             |
|   | Design of main spindles using BEARINX ..... 86                        |                             |
|   | Comparison of bearing arrangements ..... 88                           |                             |
|   | Comparison between different<br>spindle bearing arrangements ..... 89 |                             |
|   | Examples of bearing arrangements ..... 92                             |                             |
|   | <b>Mounting</b>   | Handling..... 95            |
|   |   | Provision of parts ..... 95 |
| Allocation of parts ..... 95                                  |   |                             |
| Mounting..... 95  |   |                             |
| Guidelines for mounting ..... 95                              |   |                             |
| Mounting record..... 96                                       |   |                             |
| Matching operations ..... 96                                  |   |                             |
| Greasing ..... 96   |   |                             |
| Axial clamping of inner rings..... 97                         |   |                             |
| Recommendations for shaft nuts ..... 100                      |   |                             |
| Clearance adjustment of cylindrical roller bearings ..... 100 |   |                             |
| PrecisionDesk..... 104  |   |                             |
| Mounting and dismounting ..... 107                            |   |                             |
| Rental of tools..... 107                                      |   |                             |
| Devices for the mounting of super precision bearings..... 108 |   |                             |
| Training ..... 114  |   |                             |
| Other products and services ..... 114                         |   |                             |
| <b>Bearing monitoring</b>                                     | Factors in bearing monitoring..... 115                                |                             |
|   | Types of monitoring ..... 115   |                             |
|   | Periodic monitoring ..... 115   |                             |
|   | Continuous monitoring ..... 115                                       |                             |
|   | One-off monitoring ..... 115  |                             |
| Temperature monitoring ..... 116                              |   |                             |



## Components and materials

### Steels for bearing rings and rolling elements

#### Standard rolling bearing steel 100Cr6

The bearing rings and rolling elements of FAG standard spindle bearings are made in principle from the through hardening rolling bearing steel 100Cr6. Ring made from these materials are dimensionally stabilised as standard to at least +150 °C. Other dimensional stabilisations are available by agreement.

#### High performance steel Cronidur 30

For high performance applications, especially in motor spindles with very high speeds, Schaeffler offers the bearings with rings made from the high performance steel Cronidur 30 (X30CrMonN15-1) and ceramic rolling elements. The material used for the rings is a highly nitrided, corrosion-resistant steel.

Cronidur 30 has, in comparison with the normal rolling bearing steel 100Cr6, a significantly finer structure. As a result, less heat is generated in the bearing and the permissible contact pressure is higher.

Tests on the material fatigue life have given life values higher by a factor of ten compared to 100Cr6.

In the mixed friction region, Cronidur 30 has proved highly effective in comparison with the standard material 100Cr6.

It is also significantly superior to the conventional rolling bearing steels on the criteria of corrosion resistance and high temperature hardness.

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

# Components and materials

## Materials for rolling elements

Standard bearings have rolling elements made from 100Cr6. Standard and High Speed hybrid bearings (HCB, HC..) as well as Cronidur 30 bearings are fitted with ceramic balls made from silicon nitride ( $\text{Si}_3\text{N}_4$ ). In comparison with steel rolling elements, ceramic rolling elements offer many advantages:

- excellent tribological behaviour in the combination of steel and ceramic. In hybrid bearings, the strain on the material and lubricant is significantly reduced.
- lower density. Since the mass is 60% lower than steel, the centrifugal forces on the rolling elements are reduced and the kinematics of the bearing are improved.
- a lower coefficient of thermal expansion of the ceramic rolling elements. This has a positive effect on the change in bearing preload in response to temperature differences in operation.
- no magnetism, high current insulation.

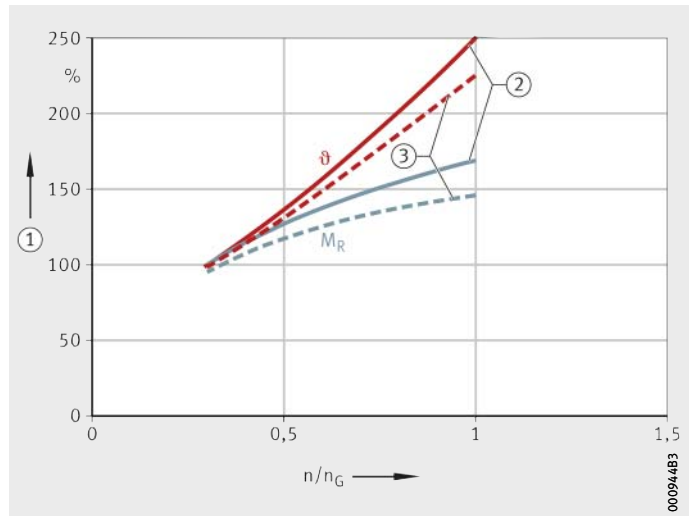
### Comparison of the rolling bearing steel 100Cr6 with silicon nitride $\text{Si}_3\text{N}_4$

| Material characteristics at room temperature | Silicon nitride $\text{Si}_3\text{N}_4$ | Rolling bearing steel 100Cr6 |             |
|--|---|------------------------------|-------------|
| Density                                      | g/cm <sup>3</sup>                       | 3,2 to 3,25                  | 7,8 to 7,85 |
| Coefficient of thermal expansion             | 10 <sup>-6</sup> K <sup>-1</sup>        | 3,2                          | 11,5        |
| Modulus of elasticity                        | kN/mm <sup>2</sup>                      | 315 to 320                   | 200 to 210  |
| Hardness                                     | HV 10                                   | 1 600                        | 700         |
| Flexural strength                            | N/mm <sup>2</sup>                       | 600, 700                     | 2 500       |
| Fracture toughness                           | MN · m <sup>-3/2</sup>                  | 7                            | 20          |
| Thermal conductivity                         | W/mK                                    | 30 to 35                     | 40 to 45    |
| Specific electrical resistance               | $\Omega \cdot \text{mm}^2\text{m}^{-1}$ | approx. 1.000                | 0,1 to 1    |

$n/n_G$  = speed relative to limiting speed  
 $M_R$  = frictional torque of bearing  
 $\vartheta$  = temperature of outer ring

- ① Relative change in frictional torque and temperature
- ② Steel bearing
- ③ Hybrid bearing

**Figure 1**  
Frictional torque and temperature profile – comparison of steel bearing/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.





## Cage function and materials for cages

The cage, as an important functional part in a rolling bearing:

- keeps the rolling elements separate from each other
- maintains the spacing between the rolling elements, thus giving more uniform load distribution
- guides the rolling elements in the unloaded zone of the bearing
- 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.

## Angular contact ball bearings

### Laminated fabric cages

FAG standard and High Speed angular contact ball bearings of P4S accuracy as well as axial bearings BAX are fitted with phenolic resin/cotton fabric cages. They are guided on the outer ring and have good emergency running characteristics (suffix - T - ). This material 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 is thus superior to many thermoplastics. The maximum operating temperature of laminated fabric cages is +100 °C.

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

### Solid brass cages

Single and double row super precision bearings of series FAG NNU49 and N10, NN30 with a bore diameter outside the range 30 to 120 mm have solid brass cages as standard (suffix M1 with crosspiece rivets, M for double row bearings). Furthermore, double direction axial angular contact ball bearings of series 2344 and 2347 are fitted with solid brass cages (suffix M).

## Polyphthalamide (PPA) cages for X-life cylindrical roller bearings

The new FAG X-life cylindrical roller bearings of series N10 and NN30 in the bore diameter range 30 to 120 mm are fitted with a window cage made from the high performance plastic PPA (polyphthalamide). 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. The lower increase in temperature ensures that speeds up to 25% higher 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%. Due to the use of the plastic cage (suffix TVP) with low mass and better damping characteristics, there is a positive change in the bearing noise – the bearings run more quietly. The maximum operating temperature of TVP cages is +100 °C.

## Components and materials

### PEEK cages for High Speed and Thermally Robust cylindrical roller bearings

High Speed and Thermally Robust (TR) super precision cylindrical roller bearings, specifically for motor spindles, are available with a cage made from PEEK (polyether ether ketone) (suffix PVPA1). Since displacement on the non-locating bearing side of motor spindles only ever occurs in one direction, the cage can be guided on one side, which leads to a more rapid grease distribution cycle with lower maximum temperatures and subsequently to a lower temperature level with smaller scatter, see page 61.

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.



Figure 2  
Cages



## Seal materials

Main spindle bearings sealed on both sides and greased “for life” of the standard series B (with large balls, suffix - 2RSD -), High Speed H and Cronidur bearings X (with small balls, prefix S) and corresponding versions of the FAG axial bearings BAX have non-contact sealing by means of sealing washers made from nitrile butadiene rubber (NBR). Bearings for pneumatic oil lubrication of the design DLR are each fitted with two O rings. Seals and O rings 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 (available by agreement).

In accordance with the REACH Directive (EC) no. 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).

## Coatings

Coatings are recommended in certain applications. In order to prevent current passage, to improve anti-corrosion and/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 on many occasions in the case of main spindle bearings in order to prevent fretting corrosion of the outer ring. This option can be added using the suffix J24), other coating options are available by agreement.

# Tolerances

## Definitions and measurement principles

Symbols for nominal dimensions, characteristics and specification modifiers for radial rolling bearings in accordance with ISO 492:2014

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



| Symbol for nominal dimension <sup>1) 2)</sup><br>Tolerance symbol for characteristic <sup>2)</sup> | GPS symbol and specification modifier  | Description for radial bearings  | Old term                               |
|--|--|--|--|
|  | Symbols in accordance with ISO 1101 and ISO 14405-1  | In accordance with ISO 492:2014 (based on ISO 1101, ISO 5459 and ISO 14405-1)  | In accordance with ISO 1132-1:2000     |
| <b>Width</b>   |  |  |  |
| <b>B</b>   | –  | Nominal inner ring width   | Nominal inner ring width               |
| $t_{\Delta B_s}$   | (LP)   | <b>Symmetrical rings</b><br>deviation of a two-point size of inner ring width from its nominal size<br>$\Delta B_s = B_s - B$<br>$B_s =$ single two-point size of inner ring width   | Deviation of a single inner ring width |
|  | (GN)ALS (LP)  | <b>Asymmetrical rings, upper limit</b><br>deviation of a minimum circumscribed size of inner ring width, between two opposite lines, in any longitudinal section which includes the inner ring bore axis, from its nominal size<br><br><b>Asymmetrical rings, lower limit</b><br>deviation of a two-point size of inner ring width from its nominal size |  |
| $t_{V B_s}$  | (LP) (SR)  | <b>Symmetrical rings</b><br>range of two-point sizes of inner ring width<br>$V B_s = B_{s \max} - B_{s \min}$  | Variation of inner ring width          |
|  | (GN)ALS (SR)  | <b>Asymmetrical rings</b><br>range of minimum circumscribed sizes of inner ring width, between two opposite lines, obtained from any longitudinal section which includes the inner ring bore axis  |  |

1) Symbols for the nominal dimension are printed bold; they indicate size dimensions and spacings.

2) Symbols in accordance with ISO 15241 (exception: font).



**Symbols for nominal dimensions, characteristics and specification modifiers for radial rolling bearings in accordance with ISO 492:2014 (continued)**

|   |  |  |  |
|---|--|--|--|
| <b>Symbol for nominal dimension<sup>1)2)</sup></b><br>Tolerance symbol for characteristic <sup>2)</sup> | GPS symbol and specification modifier  | Description for radial bearings  | Old term                               |
|   | Symbols in accordance with ISO 1101 and ISO 14405-1  | In accordance with ISO 492:2014 (based on ISO 1101, ISO 5459 and ISO 14405-1)  | In accordance with ISO 1132-1:2000     |
| <b>Width</b>  |  |  |  |
| <b>C</b>  | –  | Nominal outer ring width   | Nominal outer ring width               |
| $t_{\Delta Cs}$   | <b>LP</b>  | <b>Symmetrical rings</b><br>deviation of a two-point size of outer ring width from its nominal size<br>$\Delta Cs = Cs - C$<br>$Cs$ = single two-point size of inner ring width  | Deviation of a single outer ring width |
|   | <b>GN ALS</b> <br><b>LP</b> | <b>Asymmetrical rings, upper limit</b><br>deviation of a minimum circumscribed size of outer ring width, between two opposite lines, in any longitudinal section which includes the outer ring outside surface axis, from its nominal size |  |
|   |  | <b>Asymmetrical rings, lower limit</b><br>deviation of a two-point size of outer ring width from its nominal size  |  |
| $t_{VCs}$   | <b>LP SR</b>   | <b>Symmetrical rings</b><br>range of two-point sizes of outer ring width<br>$VCs = Cs_{max} - Cs_{min}$  | Variation of outer ring width          |
|   | <b>GN ALS SR</b>          | <b>Asymmetrical rings</b><br>range of minimum circumscribed sizes of outer ring width, between two opposite lines, obtained from any longitudinal section which includes the outer ring outside surface axis                               |  |

1) Symbols for the nominal dimension are printed bold; they indicate size dimensions and spacings.

2) Symbols in accordance with ISO 15241 (exception: font).

# Tolerances

Symbols for nominal dimensions, characteristics and specification modifiers for radial rolling bearings in accordance with ISO 492:2014 (continued)

|   |  |  |   |
|---|--|--|---|
| <b>Symbol for nominal dimension<sup>1)2)</sup></b><br>Tolerance symbol for characteristic <sup>2)</sup> | GPS symbol and specification modifier<br><br>Symbols in accordance with ISO 1101 and ISO 14405-1 | Description for radial bearings<br><br>In accordance with ISO 492:2014 (based on ISO 1101, ISO 5459 and ISO 14405-1)   | Old term<br><br>In accordance with ISO 1132-1: 2000 |
| <b>Diameter</b>   |  |  |   |
| <b>d</b>  | –  | Nominal bore diameter of a cylindrical bore or at the theoretical small end of a tapered bore  | Nominal bore diameter                               |
| $t_{\Delta ds}$   | <b>(LP)</b>  | Deviation of a two-point size of the bore diameter from its nominal size<br>$\Delta ds = ds - d$   | Deviation of a single bore diameter                 |
| $t_{Vdsp}$  | <b>(LP) (SR) ACS</b>   | 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 |
| $t_{\Delta dmp}$  | <b>(LP) (SD) ACS</b>   | <b>Cylindrical bore</b><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>$\Delta dmp = dmp - d$ | Deviation of mean bore diameter in a single plane   |
|   | <b>(LP) (SD) SCS</b>   | <b>Tapered bore</b><br>deviation of a mid-range size (out of two-point sizes) of bore diameter at the theoretical small end from its nominal size  |   |
| $t_{Vdmp}$  | <b>(LP) (SD) ACS (SR)</b>  | 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                     |

1) Symbols for the nominal dimension are printed bold; they indicate size dimensions and spacings.

2) Symbols in accordance with ISO 15241 (exception: font).



**Symbols for nominal dimensions, characteristics and specification modifiers for radial rolling bearings in accordance with ISO 492:2014 (continued)**

|   |   |  |  |
|---|---|--|--|
| <b>Symbol for nominal dimension<sup>1)2)</sup></b><br>Tolerance symbol for characteristic <sup>2)</sup> | GPS symbol and specification modifier               | Description for radial bearings  | Old term   |
|   | Symbols in accordance with ISO 1101 and ISO 14405-1 | In accordance with ISO 492:2014 (based on ISO 1101, ISO 5459 and ISO 14405-1)  | In accordance with ISO 1132-1:2000                   |
| <b>d<sub>1</sub></b>  | –   | Nominal diameter at the theoretical large end of a tapered bore  | –  |
| $t_{\Delta d1mp}$   | (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                                     | –  |
| <b>D</b>  | –   | Nominal outside diameter   | Nominal outside 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 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>$\Delta Dmp = Dmp - D$ | 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 diameter                   |

- 1) Symbols for the nominal dimension are printed bold; they indicate size dimensions and spacings.
- 2) Symbols in accordance with ISO 15241 (exception: font).

# Tolerances

Symbols for nominal dimensions, characteristics and specification modifiers for radial rolling bearings in accordance with ISO 492:2014 (continued)

|   |   |  |   |
|---|---|--|---|
| <b>Symbol for nominal dimension<sup>1)2)</sup></b><br>Tolerance symbol for characteristic <sup>2)</sup> | GPS symbol and specification modifier<br><br>Symbols in accordance with ISO 1101 and ISO 14405-1  | Description for radial bearings<br><br>In accordance with ISO 492:2014 (based on ISO 1101, ISO 5459 and ISO 14405-1)   | Old term<br><br>In accordance with ISO 1132-1: 2000                     |
| <b>Running accuracy</b>   |   |  |   |
| $t_{Kea}$   |  <sup>3)</sup>   | 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                       |
| $t_{Kia}$   |  <sup>3)</sup>   | 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                       |
| $t_{Sd}$  |  <sup>3)</sup>   | 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 |
| $t_{Sea}$   |  <sup>3)</sup> | 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                        |
| $t_{Sia}$   |  <sup>3)</sup> | 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                        |
| <b>Tapered bore</b>   |   |  |   |
| <b>SL</b>   | –   | Taper slope: Taper slope is the difference between nominal diameters at the theoretical large end and small end of a tapered bore<br>$SL = d_1 - d$<br>$SL = \text{spacing}$ | –   |
| $t_{\Delta SL}$   | –   | Deviation of taper slope of a tapered inner ring bore from its nominal size (description based on DIN EN ISO 1119)<br>$\Delta SL = \Delta d_{1mp} - \Delta d_{mp}$           | –   |
| $\alpha$  | –   | Frustum angle of tapered inner ring bore   | –   |

<sup>1)</sup> Symbols for the nominal dimension are printed bold; they indicate size dimensions and spacings.

<sup>2)</sup> Symbols in accordance with ISO 15241 (exception: font).

<sup>3)</sup> Specification modifiers for the direction of action of the mass, as well as fixed and movable parts necessary in accordance with ISO/TS 17863.





**Symbols for nominal dimensions, characteristics and specification modifiers for radial rolling bearings in accordance with ISO 492:2014 (continued)**

|   |   |   |   |
|---|---|---|---|
| <b>Symbol for nominal dimension<sup>1)2)</sup></b><br>Tolerance symbol for characteristic <sup>2)</sup> | GPS symbol and specification modifier               | Description for radial bearings   | Old term  |
|   | Symbols in accordance with ISO 1101 and ISO 14405-1 | In accordance with ISO 492:2014 (based on ISO 1101, ISO 5459 and ISO 14405-1)   | In accordance with ISO 1132-1: 2000   |
| <b>Width of assembled bearing</b>   |   |   |   |
| <b>T</b>  | –   | Nominal assembled bearing width   | Assembled bearing width   |
| $t_{\Delta Ts}$   | $\textcircled{\text{GN}}$ <sup>3)</sup>             | Deviation of minimum circumscribed size of assembled bearing width from its nominal size  | Deviation of the actual (assembled) bearing width                           |
| <b>T<sub>1</sub></b>  | –   | Nominal effective width of inner subunit assembled with a master outer ring   | Effective width of the inner subunit assembled with a master outer ring     |
| $t_{\Delta T1s}$  | $\textcircled{\text{GN}}$ <sup>3)</sup>             | Deviation of minimum circumscribed size of effective width (inner subunit assembled with a master outer ring) from its nominal size | Nominal effective width of outer ring assembled with a master inner subunit |

1) Symbols for the nominal dimension are printed bold; they indicate size dimensions and spacings.

2) Symbols in accordance with ISO 15241 (exception: font).

3) Specification modifiers for the direction of action of the mass, as well as fixed and movable parts necessary in accordance with ISO/TS 17863.

# Tolerances

Symbols for nominal dimensions, characteristics and specification modifiers for axial rolling bearings in accordance with ISO 199:2014

|   |   |   |  |
|---|---|---|--|
| Symbol for nominal dimension <sup>1)2)</sup><br>Tolerance symbol for characteristic <sup>2)</sup> | GPS symbol and specification modifier               | Description for axial bearings  | Old term   |
|   | Symbols in accordance with ISO 1101 and ISO 14405-1 | In accordance with ISO 199:2014 (based on ISO 1101, ISO 5459 and ISO 14405-1)   | In accordance with ISO 1132-1:2000                   |
| <b>Diameter</b>   |   |   |  |
| <b>d</b>  | –   | Nominal assembled bearing height, single-direction bearing  | Nominal bore diameter of shaft washer                |
| $t_{\Delta dmp}$  | (LP) (SD) 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>$\Delta dmp = dmp - d$      | Deviation of mean bore diameter in a single plane    |
| $t_{Vdsp}$  | (LP) (SR) ACS                                       | Range of two-point sizes of shaft washer bore diameter in any cross-section<br>$Vdsp = ds_{max} - ds_{min}$   | Variation of single bore diameter in a single plane  |
| <b>D</b>  | –   | Nominal outside diameter of housing washer  | Nominal outside diameter of 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>$\Delta Dmp = Dmp - D$ | 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 outside diameter in a single plane      |
| <b>Height</b>   |   |   |  |
| <b>T</b>  | –   | Nominal assembled bearing height, single-direction bearing  | Nominal bearing height                               |
| $t_{\Delta Ts}$   | (GN) <sup>3)</sup>                                  | Deviation of minimum circumscribed size of assembled bearing height from its nominal size, single-direction bearing   | Deviation of the actual bearing height               |

1) Symbols for the nominal dimension are printed bold; they indicate size dimensions and spacings.

2) Symbols in accordance with ISO 1101 and ISO 14405-1.

3) Specification modifiers for the direction of action of the mass in accordance with ISO/TS 17863.



**Symbols for nominal dimensions, characteristics and specification modifiers for axial rolling bearings in accordance with ISO 199:2014 (continued)**

| Symbol for nominal dimension <sup>1)2)</sup><br>Tolerance symbol for characteristic <sup>2)</sup> | GPS symbol and specification modifier | Description for axial bearings   | Old term  |
|---|---------------------------------------|--|---|
| <b>T<sub>1</sub></b>  | –                                     | Nominal assembled bearing height, double-direction bearing   | –   |
| <b>t<sub>ΔT1s</sub></b>   | ⓄGN <sup>3)</sup>                     | Deviation of minimum circumscribed size of assembled bearing height from its nominal size, double-direction bearing                  | –   |
| <b>t<sub>Se</sub></b> <sup>4)</sup>   | ⓄLP ⓄSR                               | <b>Axial cylindrical roller bearings:</b><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 |
|   | ⓄLS ⓄSN ALS ⓄSR <Ⓞ=                   | <b>Axial ball bearings:</b><br>range of minimum spherical sizes between the raceway and the opposite back face of the housing washer |   |
| <b>t<sub>Si</sub></b> <sup>4)</sup>   | ⓄLP ⓄSR                               | <b>Axial cylindrical roller bearings:</b><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   |
|   | ⓄLS ⓄSN ALS ⓄSR <Ⓞ=                   | <b>Axial ball bearings:</b><br>range of minimum spherical sizes between the raceway and the opposite back face of the shaft washer   |   |

- 1) Symbols for the nominal dimension are printed bold; they indicate size dimensions and spacings.
- 2) Symbols in accordance with ISO 1101 and ISO 14405-1.
- 3) Specification modifiers for the direction of action of the mass in accordance with ISO/TS 17863.
- 4) Valid only for axial ball bearings and axial cylindrical roller bearings with a 90° contact angle.

# Tolerances

## 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 DIN 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. P4S means: main deviations at least in accordance with ISO tolerance class 4; all geometrical and running tolerances in accordance with ISO tolerance class 2.

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, see table, page 35 and table, page 36. In this case, the roundness and running tolerances correspond to at least ISO tolerance class 4. For higher accuracy requirements, super precision cylindrical roller bearings are also available to the accuracy class UP, see table, page 39 and table, page 40.

## Dimensional, geometrical and positional tolerances of spindle bearings and BAX

In order to ensure full use of the bearing performance capability and a high machining accuracy, the dimensional, geometrical and positional accuracy of FAG spindle bearings is produced within very narrow tolerance ranges. The bearing tolerances conform to P4, the running accuracy and parallelism conform to P2.

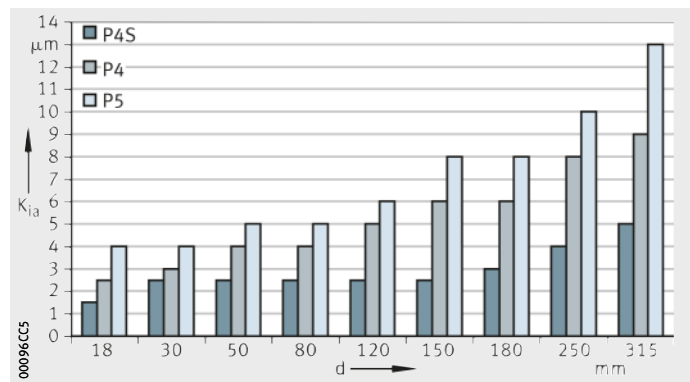
P4S is a Schaeffler standard that is better than P4 in accordance with DIN 620.

The radial runout tolerance of the inner ring for P4S, P4, P5 is shown in *Figure 1*.

The tolerances of the inner and outer ring for tolerance class P4S are shown in the tables from page 31 to page 32.

$K_{ia}$  = radial runout  
d = bore diameter

*Figure 1*  
Radial runout tolerances of the inner ring with P4S, P4, P5



## 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, while the tolerance width is 1/3 of the diameter tolerance. The diameter tolerances stated are thus narrower than P2. Tolerances for K5, see tables, page 33.



**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, *Figure 9* and *Figure 10*, page 131.

**Tolerances of inner and outer ring**

Tolerances of the inner and outer ring in spindle bearings and BAX, see tables.

**Tolerances of the inner ring (tolerance class P4S)**

| Nominal bearing bore diameter |       | Deviation  |     | Variation of width         | Width deviation                  |      |
|-------------------------------|-------|--|-----|----------------------------|----------------------------------|------|
| d mm                          |       | $t_{\Delta dmp}^{1)}$ , $t_{\Delta ds}$<br>$\mu\text{m}$ |     | $t_{VBs}$<br>$\mu\text{m}$ | $t_{\Delta Bs}$<br>$\mu\text{m}$ |      |
| over                          | incl. |  |     |                            |                                  |      |
| -                             | 10    | 0  | -4  | 1,5                        | 0                                | -100 |
| 10                            | 18    | 0  | -4  | 1,5                        | 0                                | -100 |
| 18                            | 30    | 0  | -5  | 1,5                        | 0                                | -120 |
| 30                            | 50    | 0  | -6  | 1,5                        | 0                                | -120 |
| 50                            | 80    | 0  | -7  | 1,5                        | 0                                | -150 |
| 80                            | 120   | 0  | -8  | 2,5                        | 0                                | -200 |
| 120                           | 150   | 0  | -10 | 2,5                        | 0                                | -250 |
| 150                           | 180   | 0  | -10 | 4                          | 0                                | -250 |
| 180                           | 250   | 0  | -12 | 5                          | 0                                | -300 |
| 250                           | 315   | 0  | -15 | 6                          | 0                                | -350 |
| 315                           | 400   | 0  | -19 | 7                          | 0                                | -400 |
| 400                           | 500   | 0  | -23 | 8                          | 0                                | -450 |
| 500                           | 630   | 0  | -26 | 10                         | 0                                | -500 |
| 630                           | 800   | 0  | -32 | 12                         | 0                                | -750 |

<sup>1)</sup> For series 719.

**Tolerances of the inner ring (tolerance class P4S) continued**

| Nominal bearing bore diameter |       | Variation (out of roundness) |            | Variation of mean diameter  | Radial runout              | Axial runout              |                            |
|-------------------------------|-------|------------------------------|------------|-----------------------------|----------------------------|---------------------------|----------------------------|
| d mm                          |       | $t_{Vdsp}$<br>$\mu\text{m}$  |            | $t_{Vdmp}$<br>$\mu\text{m}$ | $t_{Kia}$<br>$\mu\text{m}$ | $t_{Sd}$<br>$\mu\text{m}$ | $t_{Sia}$<br>$\mu\text{m}$ |
| over                          | incl. | Series 9                     | Series 0,2 |                             |                            |                           |                            |
| -                             | 10    | 2,5                          | 2          | 1,5                         | 1,5                        | 1,5                       | 1,5                        |
| 10                            | 18    | 2,5                          | 2          | 1,5                         | 1,5                        | 1,5                       | 1,5                        |
| 18                            | 30    | 2,5                          | 2          | 1,5                         | 2,5                        | 1,5                       | 2,5                        |
| 30                            | 50    | 3                            | 2,5        | 2                           | 2,5                        | 1,5                       | 2,5                        |
| 50                            | 80    | 3,5                          | 3          | 2                           | 2,5                        | 1,5                       | 2,5                        |
| 80                            | 120   | 4                            | 3          | 2,5                         | 2,5                        | 2,5                       | 2,5                        |
| 120                           | 150   | 5                            | 3          | 3                           | 2,5                        | 2,5                       | 2,5                        |
| 150                           | 180   | 5                            | 4          | 3                           | 3                          | 4                         | 5                          |
| 180                           | 250   | 6                            | 4          | 4                           | 4                          | 5                         | 5                          |
| 250                           | 315   | 8                            | 5          | 5                           | 5                          | 6                         | 7                          |
| 315                           | 400   | 10                           | 6          | 6                           | 7                          | 7                         | 9                          |
| 400                           | 500   | 12                           | 8          | 8                           | 8                          | 8                         | 11                         |
| 500                           | 630   | 13                           | 10         | 8                           | 9                          | 10                        | 13                         |
| 630                           | 800   | 16                           | 10         | 10                          | 10                         | 12                        | 15                         |

# Tolerances

## Tolerances of the outer ring (tolerance class P4S)

| Nominal outside diameter |       | Deviation   |     | Variation (out of roundness)     |            |
|--------------------------|-------|---|-----|----------------------------------|------------|
| D<br>mm                  |       | $t_{\Delta Ds}^{1)}$ , $t_{\Delta Dmp}^{2)}$<br>$\mu\text{m}$ |     | $t_{VDsp}^{3)}$<br>$\mu\text{m}$ |            |
| over                     | incl. |   |     | Series 9                         | Series 0,2 |
| 10                       | 18    | 0   | -4  | 2,5                              | 2          |
| 18                       | 30    | 0   | -5  | 2,5                              | 2          |
| 30                       | 50    | 0   | -6  | 3                                | 2,5        |
| 50                       | 80    | 0   | -7  | 3,5                              | 3          |
| 80                       | 120   | 0   | -8  | 4                                | 3          |
| 120                      | 150   | 0   | -9  | 5                                | 4          |
| 150                      | 180   | 0   | -10 | 5                                | 4          |
| 180                      | 250   | 0   | -11 | 6                                | 5          |
| 250                      | 315   | 0   | -13 | 7                                | 6          |
| 315                      | 400   | 0   | -15 | 8                                | 6          |
| 400                      | 500   | 0   | -18 | 9                                | 7          |
| 500                      | 630   | 0   | -22 | 11                               | 9          |
| 630                      | 800   | 0   | -26 | 13                               | 10         |
| 800                      | 1000  | 0   | -33 | 17                               | 14         |

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

- 1) For BAX, the tolerance position is displaced by 50  $\mu\text{m}$ .  
Example: for BAX70, the tolerance range is -50 ... -57
- 2) For series 719.
- 3) Valid for open bearings;  
for sealed bearings and DLR bearings, the values apply before assembly.

## Tolerances of the outer ring (tolerance class P4S) continued

| Nominal outside diameter |       | Variation of mean diameter  | Variation of width        | Radial runout              | Axial runout              |                           |
|--------------------------|-------|-----------------------------|---------------------------|----------------------------|---------------------------|---------------------------|
| D<br>mm                  |       | $t_{Vdmp}$<br>$\mu\text{m}$ | $t_{Cs}$<br>$\mu\text{m}$ | $t_{Kea}$<br>$\mu\text{m}$ | $t_{Si}$<br>$\mu\text{m}$ | $t_{Se}$<br>$\mu\text{m}$ |
| over                     | incl. |                             |                           |                            |                           |                           |
| 10                       | 18    | 1,5                         | 1,5                       | 1,5                        | 0,75                      | 1,5                       |
| 18                       | 30    | 1,5                         | 1,5                       | 2,5                        | 0,75                      | 2,5                       |
| 30                       | 50    | 2                           | 1,5                       | 2,5                        | 0,75                      | 2,5                       |
| 50                       | 80    | 2                           | 1,5                       | 3                          | 0,75                      | 4                         |
| 80                       | 120   | 2,5                         | 2,5                       | 4                          | 1,25                      | 5                         |
| 120                      | 150   | 3                           | 2,5                       | 4                          | 1,25                      | 5                         |
| 150                      | 180   | 3                           | 2,5                       | 5                          | 1,25                      | 5                         |
| 180                      | 250   | 4                           | 4                         | 7                          | 2                         | 7                         |
| 250                      | 315   | 4                           | 5                         | 7                          | 2,5                       | 7                         |
| 315                      | 400   | 5                           | 7                         | 8                          | 3,5                       | 8                         |
| 400                      | 500   | 6                           | 7                         | 9                          | 4                         | 10                        |
| 500                      | 630   | 7                           | 8                         | 11                         | 4,5                       | 12                        |
| 630                      | 800   | 8                           | 9                         | 13                         | 5                         | 14                        |
| 800                      | 1000  | 11                          | 11                        | 15                         | 6                         | 17                        |



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

| Nominal bearing bore diameter<br>d<br>mm |       | Deviation<br>$t_{\Delta D_s}, t_{\Delta D_{mp}}^{1)}$<br>$\mu\text{m}$ |      |
|--|-------|--|------|
| 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  |

1) For series 719.

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

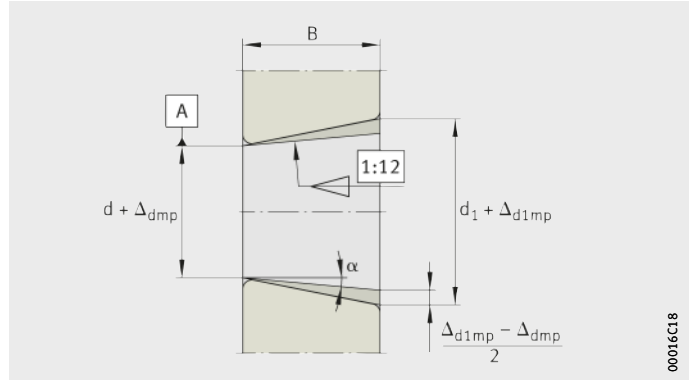
| Nominal outside diameter<br>D<br>mm |       | Deviation<br>$t_{\Delta D_s}, t_{\Delta D_{mp}}$<br>$\mu\text{m}$ |      |
|-------------------------------------|-------|---|------|
| over                                | incl. |   |      |
| 10                                  | 18    | –1,5  | –3   |
| 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  |

# Tolerances

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

- $\alpha$  = inclination angle at end of taper  
=  $2^{\circ} 23' 9,4''$
- $2\alpha$  = taper angle at end of taper  
=  $4^{\circ} 46' 18,8''$
- B = width of inner ring
- d = nominal bearing bore diameter  
 $d_1$  = bore diameter at large end of taper
- $\Delta_{dmp}$  = deviation of bore diameter from nominal dimension in a single radial plane

Deviation of the tapered bore  $\Delta_{dmp}$ , see *Figure 2* and tables.



*Figure 2*

Tolerances for tapered bores





**Tolerances of class SP  
for single row bearings**

The following values are valid for the series N10, N19 and HCN10.

**Tolerances of the inner ring  
(tolerance class SP)**

| Nominal bore diameter |       | Deviation of cylindrical bore             |     | Deviation of tapered bore   |   | Variation of width   | Width deviation            |      |
|-----------------------|-------|---|-----|-----------------------------|---|----------------------|----------------------------|------|
| d<br>mm               |       | $t_{\Delta d}, t_{\Delta dmp}$<br>$\mu m$ |     | $t_{\Delta dmp}$<br>$\mu m$ |   | $t_{VBs}$<br>$\mu m$ | $t_{\Delta Bs}$<br>$\mu m$ |      |
| over                  | incl. |   |     |                             |   |                      |                            |      |
| 18                    | 30    | 0   | -6  | 10                          | 0 | 1,5                  | 0                          | -120 |
| 30                    | 50    | 0   | -8  | 12                          | 0 | 2                    | 0                          | -120 |
| 50                    | 80    | 0   | -9  | 15                          | 0 | 3                    | 0                          | -150 |
| 80                    | 120   | 0   | -10 | 20                          | 0 | 3                    | 0                          | -200 |
| 120                   | 180   | 0   | -13 | 25                          | 0 | 4                    | 0                          | -250 |
| 180                   | 250   | 0   | -15 | 30                          | 0 | 5                    | 0                          | -300 |
| 250                   | 315   | 0   | -18 | 35                          | 0 | 6                    | 0                          | -350 |
| 315                   | 400   | 0   | -23 | 40                          | 0 | 7                    | 0                          | -400 |
| 400                   | 500   | 0   | -27 | 45                          | 0 | 8                    | 0                          | -450 |
| 500                   | 630   | 0   | -30 | 50                          | 0 | 10                   | 0                          | -500 |
| 630                   | 800   | 0   | -40 | 65                          | 0 | 12                   | 0                          | -750 |

**Tolerances of the inner ring  
(tolerance class SP)  
continued**

| Nominal bore diameter |       | Variation (out of roundness) |         | Variation of mean diameter | Deviation                                     |   | Radial runout        | Axial runout        |                      |
|-----------------------|-------|------------------------------|---------|----------------------------|---|---|----------------------|---------------------|----------------------|
| d<br>mm               |       | $t_{Vdsp}$<br>$\mu m$        |         | $t_{Vdmp}$<br>$\mu m$      | $t_{\Delta d1mp} - t_{\Delta dmp}$<br>$\mu m$ |   | $t_{Kia}$<br>$\mu m$ | $t_{Sd}$<br>$\mu m$ | $t_{Sia}$<br>$\mu m$ |
| over                  | incl. | cylindrical                  | tapered |                            |   |   |                      |                     |                      |
| 18                    | 30    | 3                            | 3       | 3                          | 4   | 0 | 3                    | 3                   | 4                    |
| 30                    | 50    | 4                            | 4       | 4                          | 4   | 0 | 4                    | 3                   | 4                    |
| 50                    | 80    | 5                            | 5       | 5                          | 5   | 0 | 4                    | 4                   | 5                    |
| 80                    | 120   | 5                            | 5       | 5                          | 6   | 0 | 5                    | 4                   | 5                    |
| 120                   | 180   | 7                            | 7       | 7                          | 8   | 0 | 6                    | 5                   | 7                    |
| 180                   | 250   | 8                            | 8       | 8                          | 9   | 0 | 8                    | 6                   | 8                    |
| 250                   | 315   | 9                            | 9       | 9                          | 11  | 0 | 9                    | 7                   | 10                   |
| 315                   | 400   | 12                           | 12      | 12                         | 12  | 0 | 10                   | 9                   | 12                   |
| 400                   | 500   | 14                           | 14      | 14                         | 14  | 0 | 12                   | 11                  | 15                   |
| 500                   | 630   | 15                           | 15      | 15                         | 15  | 0 | 14                   | 13                  | 18                   |
| 630                   | 800   | 20                           | 20      | 20                         | 18  | 0 | 17                   | 15                  | 21                   |

# Tolerances

## Tolerances of the outer ring (tolerance class SP)

| Nominal outside diameter |       | Deviation of outside diameter                        |     | Variation (out of roundness) |
|--------------------------|-------|--|-----|------------------------------|
| D<br>mm                  |       | $t_{\Delta D_s}, t_{\Delta D_{mp}}$<br>$\mu\text{m}$ |     | $t_{VDsp}$<br>$\mu\text{m}$  |
| over                     | incl. |  |     |                              |
| 30                       | 50    | 0  | -7  | 4                            |
| 50                       | 80    | 0  | -9  | 5                            |
| 80                       | 120   | 0  | -10 | 5                            |
| 120                      | 150   | 0  | -11 | 6                            |
| 150                      | 180   | 0  | -13 | 7                            |
| 180                      | 250   | 0  | -15 | 8                            |
| 250                      | 315   | 0  | -18 | 9                            |
| 315                      | 400   | 0  | -20 | 10                           |
| 400                      | 500   | 0  | -23 | 12                           |
| 500                      | 630   | 0  | -28 | 14                           |
| 630                      | 800   | 0  | -35 | 18                           |
| 800                      | 1000  | 0  | -40 | 20                           |

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

## Tolerances of the outer ring (tolerance class SP) continued

| Nominal outside diameter |       | Variation of mean diameter  | Variation of width         | Radial runout              | Inclination variation     | Axial runout              |
|--------------------------|-------|-----------------------------|----------------------------|----------------------------|---------------------------|---------------------------|
| D<br>mm                  |       | $t_{VDmp}$<br>$\mu\text{m}$ | $t_{C_s}$<br>$\mu\text{m}$ | $t_{Kea}$<br>$\mu\text{m}$ | $t_{Si}$<br>$\mu\text{m}$ | $t_{Se}$<br>$\mu\text{m}$ |
| over                     | incl. |                             |                            |                            |                           |                           |
| 30                       | 50    | 4                           | 2,5                        | 5                          | 2                         | 5                         |
| 50                       | 80    | 5                           | 3                          | 5                          | 2                         | 5                         |
| 80                       | 120   | 5                           | 4                          | 6                          | 2,5                       | 6                         |
| 120                      | 150   | 6                           | 5                          | 7                          | 2,5                       | 7                         |
| 150                      | 180   | 7                           | 5                          | 8                          | 2,5                       | 8                         |
| 180                      | 250   | 8                           | 7                          | 10                         | 3,5                       | 10                        |
| 250                      | 315   | 9                           | 7                          | 11                         | 4                         | 10                        |
| 315                      | 400   | 10                          | 8                          | 13                         | 5                         | 13                        |
| 400                      | 500   | 12                          | 9                          | 15                         | 5,5                       | 15                        |
| 500                      | 630   | 14                          | 11                         | 17                         | 6,5                       | 18                        |
| 630                      | 800   | 18                          | 13                         | 20                         | 7,5                       | 22                        |
| 800                      | 1000  | 20                          | 15                         | 23                         | 8,5                       | 26                        |



**Tolerances of class SP  
for double row  
cylindrical roller bearings**

The following values are valid for the series NN30 and NNU49.

**Tolerances of the inner ring  
(tolerance class SP)**

| Nominal bore diameter<br>d<br>mm |       | Deviation of cylindrical bore<br>$t_{\Delta Ds}, t_{\Delta Dmp}$<br>$\mu\text{m}$ |     | Deviation of tapered bore<br>$t_{\Delta dmp}$<br>$\mu\text{m}$ |   | Variation of width<br>$t_{VBs}$<br>$\mu\text{m}$ |   | Width deviation<br>$t_{\Delta Bs}$<br>$\mu\text{m}$ |      |
|----------------------------------|-------|---|-----|--|---|--|---|---|------|
| over                             | incl. |   |     |  |   |  |   |   |      |
| 18                               | 30    | 0   | -6  | 10   | 0 | 2,5  | 0 | 0   | -120 |
| 30                               | 50    | 0   | -8  | 12   | 0 | 3  | 0 | 0   | -120 |
| 50                               | 80    | 0   | -9  | 15   | 0 | 4  | 0 | 0   | -150 |
| 80                               | 120   | 0   | -10 | 20   | 0 | 4  | 0 | 0   | -200 |
| 120                              | 180   | 0   | -13 | 25   | 0 | 5  | 0 | 0   | -250 |
| 180                              | 250   | 0   | -15 | 30   | 0 | 6  | 0 | 0   | -300 |
| 250                              | 315   | 0   | -18 | 35   | 0 | 8  | 0 | 0   | -350 |
| 315                              | 400   | 0   | -23 | 40   | 0 | 10   | 0 | 0   | -400 |
| 400                              | 500   | 0   | -27 | 45   | 0 | 12   | 0 | 0   | -450 |
| 500                              | 630   | 0   | -30 | 50   | 0 | 14   | 0 | 0   | -500 |
| 630                              | 800   | 0   | -40 | 65   | 0 | 17   | 0 | 0   | -750 |

**Tolerances of the inner ring  
(tolerance class SP)  
continued**

| Nominal bore diameter<br>d<br>mm |       | Variation (out of roundness)<br>$t_{vdsp}$<br>$\mu\text{m}$<br>Bore |         | Variation of mean diameter<br>$t_{vdmp}$<br>$\mu\text{m}$ | Deviation<br>$t_{\Delta d1mp} - t_{\Delta dmp}$<br>$\mu\text{m}$ |   | Radial runout<br>$t_{Kia}$<br>$\mu\text{m}$ | Axial runout<br>$t_{Sd}$ $t_{Sia}$<br>$\mu\text{m}$ $\mu\text{m}$ |    |
|----------------------------------|-------|---|---------|---|--|---|---|---|----|
| over                             | incl. | cylindrical   | tapered |   |  |   |   |   |    |
| 18                               | 30    | 3   | 3       | 3   | 4  | 0 | 3   | 4   | 4  |
| 30                               | 50    | 4   | 4       | 4   | 4  | 0 | 4   | 4   | 4  |
| 50                               | 80    | 5   | 5       | 5   | 5  | 0 | 4   | 5   | 5  |
| 80                               | 120   | 5   | 5       | 5   | 6  | 0 | 5   | 5   | 5  |
| 120                              | 180   | 7   | 7       | 7   | 8  | 0 | 6   | 6   | 7  |
| 180                              | 250   | 8   | 8       | 8   | 9  | 0 | 8   | 7   | 8  |
| 250                              | 315   | 9   | 9       | 9   | 11   | 0 | 8   | 8   | 10 |
| 315                              | 400   | 12  | 12      | 12  | 12   | 0 | 10  | 10  | 12 |
| 400                              | 500   | 14  | 14      | 14  | 14   | 0 | 10  | 12  | 15 |
| 500                              | 630   | 15  | 15      | 15  | 15   | 0 | 12  | 14  | 18 |
| 630                              | 800   | 20  | 20      | 20  | 18   | 0 | 15  | 17  | 21 |

# Tolerances

## Tolerances of the outer ring (tolerance class SP)

| Nominal outside diameter |       | Deviation of outside diameter                    |     | Variation (out of roundness) |
|--------------------------|-------|--|-----|------------------------------|
| D mm                     |       | $t_{\Delta Ds}, t_{\Delta Dmp}$<br>$\mu\text{m}$ |     | $t_{VDsp}$<br>$\mu\text{m}$  |
| over                     | incl. |  |     |                              |
| 30                       | 50    | 0  | -7  | 4                            |
| 50                       | 80    | 0  | -9  | 5                            |
| 80                       | 120   | 0  | -10 | 5                            |
| 120                      | 150   | 0  | -11 | 6                            |
| 150                      | 180   | 0  | -13 | 7                            |
| 180                      | 250   | 0  | -15 | 8                            |
| 250                      | 315   | 0  | -18 | 9                            |
| 315                      | 400   | 0  | -20 | 10                           |
| 400                      | 500   | 0  | -23 | 12                           |
| 500                      | 630   | 0  | -28 | 14                           |
| 630                      | 800   | 0  | -35 | 18                           |
| 800                      | 1000  | 0  | -40 | 20                           |

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

## Tolerances of the outer ring (tolerance class SP) continued

| Nominal outside diameter |       | Variation of mean diameter         | Variation of width         | Radial runout              | Inclination variation     | Runout                    |
|--------------------------|-------|------------------------------------|----------------------------|----------------------------|---------------------------|---------------------------|
| D mm                     |       | $t_{V\Delta Dmp}$<br>$\mu\text{m}$ | $t_{VCs}$<br>$\mu\text{m}$ | $t_{Kea}$<br>$\mu\text{m}$ | $t_{Si}$<br>$\mu\text{m}$ | $t_{Se}$<br>$\mu\text{m}$ |
| over                     | incl. |                                    |                            |                            |                           |                           |
| 30                       | 50    | 4                                  | 2,5                        | 5                          | 2                         | 5                         |
| 50                       | 80    | 5                                  | 3                          | 5                          | 2                         | 5                         |
| 80                       | 120   | 5                                  | 4                          | 6                          | 2,5                       | 6                         |
| 120                      | 150   | 6                                  | 5                          | 7                          | 2,5                       | 7                         |
| 150                      | 180   | 7                                  | 5                          | 8                          | 2,5                       | 8                         |
| 180                      | 250   | 8                                  | 7                          | 10                         | 3,5                       | 10                        |
| 250                      | 315   | 9                                  | 7                          | 11                         | 4                         | 10                        |
| 315                      | 400   | 10                                 | 8                          | 13                         | 5                         | 13                        |
| 400                      | 500   | 12                                 | 9                          | 15                         | 5,5                       | 15                        |
| 500                      | 630   | 14                                 | 11                         | 17                         | 6,5                       | 18                        |
| 630                      | 800   | 18                                 | 13                         | 20                         | 7,5                       | 22                        |
| 800                      | 1000  | 20                                 | 15                         | 23                         | 8,5                       | 26                        |



**Tolerances of class UP  
for single and double row  
cylindrical roller bearings**

The following values are valid for single and double row cylindrical roller bearings.

**Tolerances of the inner ring  
(tolerance class UP)**

| Nominal bore diameter<br>d<br>mm |       | Deviation of cylindrical bore<br>$t_{\Delta Ds}, t_{\Delta Dmp}$<br>$\mu\text{m}$ |     | Deviation of tapered bore<br>$t_{\Delta dmp}$<br>$\mu\text{m}$ |   | Variation of width<br>$t_{VBs}$<br>$\mu\text{m}$ |   | Width deviation<br>$t_{\Delta Bs}$<br>$\mu\text{m}$ |  |
|----------------------------------|-------|---|-----|--|---|--|---|---|--|
| over                             | incl. |   |     |  |   |  |   |   |  |
| 18                               | 30    | 0   | -5  | 6  | 0 | 1,5  | 0 | -25   |  |
| 30                               | 50    | 0   | -6  | 7  | 0 | 2  | 0 | -30   |  |
| 50                               | 80    | 0   | -7  | 8  | 0 | 2,5  | 0 | -40   |  |
| 80                               | 120   | 0   | -8  | 10   | 0 | 3  | 0 | -50   |  |
| 120                              | 180   | 0   | -10 | 12   | 0 | 4  | 0 | -60   |  |
| 180                              | 250   | 0   | -12 | 14   | 0 | 5  | 0 | -75   |  |
| 250                              | 315   | 0   | -15 | 15   | 0 | 5  | 0 | -100  |  |
| 315                              | 400   | 0   | -19 | 17   | 0 | 6  | 0 | -100  |  |
| 400                              | 500   | 0   | -23 | 19   | 0 | 7  | 0 | -100  |  |
| 500                              | 630   | 0   | -26 | 20   | 0 | 8  | 0 | -125  |  |
| 630                              | 800   | 0   | -34 | 22   | 0 | 11   | 0 | -125  |  |

**Tolerances of the inner ring  
(tolerance class UP)  
continued**

| Nominal bore diameter<br>d<br>mm |       | Variation (out of roundness)<br>$t_{vdsp}$<br>$\mu\text{m}$<br>Bore |         | Variation of mean diameter<br>$t_{vdmp}$<br>$\mu\text{m}$ | Deviation<br>$t_{\Delta d1mp} - t_{\Delta dmp}$<br>$\mu\text{m}$ |   | Radial runout<br>$t_{Kia}$<br>$\mu\text{m}$ | Axial runout<br>$t_{Sd}$ $t_{Sia}$<br>$\mu\text{m}$ $\mu\text{m}$ |    |
|----------------------------------|-------|---|---------|---|--|---|---|---|----|
| over                             | incl. | cylindrical   | tapered |   |  |   |   |   |    |
| 18                               | 30    | 2,5   | 2,5     | 2,5   | 2  | 0 | 1,5   | 3   | 3  |
| 30                               | 50    | 3   | 3       | 3   | 3  | 0 | 2   | 3   | 3  |
| 50                               | 80    | 3,5   | 3,5     | 3,5   | 3  | 0 | 2   | 4   | 3  |
| 80                               | 120   | 4   | 4       | 4   | 4  | 0 | 3   | 4   | 4  |
| 120                              | 180   | 5   | 5       | 5   | 4  | 0 | 3   | 5   | 6  |
| 180                              | 250   | 6   | 6       | 6   | 5  | 0 | 4   | 6   | 7  |
| 250                              | 315   | 8   | 8       | 8   | 6  | 0 | 4   | 6   | 8  |
| 315                              | 400   | 10  | 10      | 10  | 6  | 0 | 5   | 7   | 9  |
| 400                              | 500   | 12  | 12      | 12  | 7  | 0 | 5   | 8   | 10 |
| 500                              | 630   | 13  | 13      | 13  | 8  | 0 | 6   | 9   | 12 |
| 630                              | 800   | 17  | 17      | 17  | 9  | 0 | 7   | 11  | 18 |

# Tolerances

## Tolerances of the outer ring (tolerance class UP)

| Nominal outside diameter |       | Deviation of outside diameter                    |     | Variation (out of roundness) |
|--------------------------|-------|--|-----|------------------------------|
| D mm                     |       | $t_{\Delta Ds}, t_{\Delta Dmp}$<br>$\mu\text{m}$ |     | $t_{VDsp}$<br>$\mu\text{m}$  |
| over                     | incl. |  |     |                              |
| 30                       | 50    | 0  | -5  | 3                            |
| 50                       | 80    | 0  | -6  | 3                            |
| 80                       | 120   | 0  | -7  | 4                            |
| 120                      | 150   | 0  | -8  | 4                            |
| 150                      | 180   | 0  | -9  | 5                            |
| 180                      | 250   | 0  | -10 | 5                            |
| 250                      | 315   | 0  | -12 | 6                            |
| 315                      | 400   | 0  | -14 | 7                            |
| 400                      | 500   | 0  | -17 | 9                            |
| 500                      | 630   | 0  | -20 | 10                           |
| 630                      | 800   | 0  | -25 | 13                           |
| 800                      | 1000  | 0  | -30 | 15                           |

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

## Tolerances of the outer ring (tolerance class UP) continued

| Nominal outside diameter |       | Variation of mean diameter  | Variation of width         | Radial runout              | Inclination variation     | Axial runout              |
|--------------------------|-------|-----------------------------|----------------------------|----------------------------|---------------------------|---------------------------|
| D mm                     |       | $t_{VDmp}$<br>$\mu\text{m}$ | $t_{VCs}$<br>$\mu\text{m}$ | $t_{Kea}$<br>$\mu\text{m}$ | $t_{Si}$<br>$\mu\text{m}$ | $t_{Se}$<br>$\mu\text{m}$ |
| over                     | incl. |                             |                            |                            |                           |                           |
| 30                       | 50    | 3                           | 1,5                        | 3                          | 1                         | 3                         |
| 50                       | 80    | 3                           | 2                          | 3                          | 1                         | 4                         |
| 80                       | 120   | 4                           | 3                          | 3                          | 1,5                       | 5                         |
| 120                      | 150   | 4                           | 4                          | 4                          | 1,5                       | 5                         |
| 150                      | 180   | 5                           | 4                          | 4                          | 1,5                       | 5                         |
| 180                      | 250   | 5                           | 5                          | 5                          | 2                         | 7                         |
| 250                      | 315   | 6                           | 5                          | 6                          | 2                         | 7                         |
| 315                      | 400   | 7                           | 6                          | 7                          | 2,5                       | 8                         |
| 400                      | 500   | 9                           | 7                          | 8                          | 2,5                       | 10                        |
| 500                      | 630   | 10                          | 8                          | 9                          | 3                         | 12                        |
| 630                      | 800   | 13                          | 11                         | 11                         | 3,5                       | 14                        |
| 800                      | 1000  | 15                          | 12                         | 12                         | 5                         | 17                        |



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

The dimensional, geometrical and running tolerances correspond to tolerance class SP in accordance with Schaeffler Group. Bearings of tolerance class UP are available by agreement.

### Tolerances of the shaft locating washer (tolerance class SP)

| Nominal bore diameter |       | Deviation                   |     | Variation (out of roundness) | Wall thickness variation | Height deviation           |      |
|-----------------------|-------|-----------------------------|-----|------------------------------|--------------------------|----------------------------|------|
| d<br>mm               |       | $t_{\Delta dmp}$<br>$\mu m$ |     | $t_{Vdsp}$<br>$\mu m$        | $t_{\zeta i}$<br>$\mu m$ | $t_{\Delta Hs}$<br>$\mu m$ |      |
| 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 |

### Tolerances of the shaft locating washer (tolerance class UP)

| Nominal bore diameter |       | Deviation                   |     | Variation (out of roundness) | Wall thickness variation | Height deviation           |      |
|-----------------------|-------|-----------------------------|-----|------------------------------|--------------------------|----------------------------|------|
| d<br>mm               |       | $t_{\Delta dmp}$<br>$\mu m$ |     | $t_{Vdsp}$<br>$\mu m$        | $t_{\zeta i}$<br>$\mu m$ | $t_{\Delta Hs}$<br>$\mu m$ |      |
| over                  | incl. |                             |     |                              |                          |                            |      |
| 18                    | 30    | 0                           | -6  | 5                            | 1,5                      | 50                         | -150 |
| 30                    | 50    | 0                           | -8  | 6                            | 1,5                      | 75                         | -200 |
| 50                    | 80    | 0                           | -9  | 7                            | 2                        | 100                        | -250 |
| 80                    | 120   | 0                           | -10 | 8                            | 2                        | 125                        | -300 |
| 120                   | 150   | 0                           | -13 | 10                           | 3                        | 150                        | -350 |
| 150                   | 180   | 0                           | -13 | 10                           | 3                        | 150                        | -350 |
| 180                   | 250   | 0                           | -15 | 12                           | 3                        | 175                        | -400 |
| 250                   | 315   | 0                           | -18 | 14                           | 4                        | 200                        | -450 |
| 315                   | 400   | 0                           | -23 | 18                           | 4                        | 250                        | -600 |
| 400                   | 500   | 0                           | -27 | 20                           | 5                        | 300                        | -750 |

# Tolerances

The machining tolerances of the housing locating washer (bearings of tolerance class SP or UP) are shown in the tables.

**Tolerances  
of the housing locating washer  
(tolerance class SP)**

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

**Tolerances  
of the housing locating washer  
(tolerance class UP)**

| Nominal outside diameter |       | Deviation of outside diameter  |     | Variation (out of roundness) | Wall thickness variation | Width deviation               |
|--------------------------|-------|--------------------------------|-----|------------------------------|--------------------------|-------------------------------|
| D mm                     |       | $t_{\Delta Dmp}$ $\mu\text{m}$ |     | $t_{VDsp}$ $\mu\text{m}$     | $t_{Se}$ $\mu\text{m}$   | $t_{\Delta Cs}$ $\mu\text{m}$ |
| over                     | incl. |                                |     |                              |                          |                               |
| 30                       | 50    | -20                            | -36 | 5                            | 1,5                      | -120                          |
| 50                       | 80    | -24                            | -43 | 6                            | 2                        | -120                          |
| 80                       | 120   | -28                            | -50 | 8                            | 2                        | -125                          |
| 120                      | 150   | -33                            | -58 | 9                            | 3                        | -125                          |
| 150                      | 180   | -33                            | -58 | 9                            | 3                        | -125                          |
| 180                      | 250   | -37                            | -66 | 10                           | 3                        | -125                          |
| 250                      | 315   | -41                            | -73 | 12                           | 4                        | -150                          |
| 315                      | 400   | -46                            | -82 | 13                           | 4                        | -150                          |
| 400                      | 500   | -50                            | -90 | 15                           | 5                        | -200                          |
| 500                      | 630   | -55                            | -99 | 16                           | 6                        | -200                          |
| 630                      | 800   | -55                            | -99 | 18                           | 7                        | -250                          |





## Chamfer dimensions

The tables describe the chamfer dimensions for:

- radial bearings with a cylindrical bore
- radial bearings with a tapered bore, see table, page 44
- axial bearings, see table, page 45.

For  $r_{\min}$ ,  $r_{1 \min}$ ,  $r_{\max}$ ,  $r_{s \max}$ ,  $r_{\max a}$ ,  $r_{1 \max a}$  and measurement spacing  $a$ , see *Figure 3*, page 45.

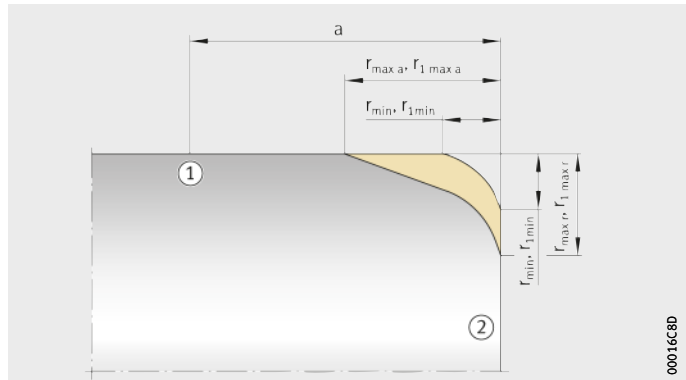
### Chamfer dimension of radial bearings with cylindrical bore

| Bore |       | Chamfer dimension          |  |   | Measurement spacing |
|------|-------|----------------------------|--|---|---------------------|
| d    |       | $r_{\min}$<br>$r_{1 \min}$ | radial<br>$r_{\max r}$<br>$r_{s \max r}$ | axial<br>$r_{\max a}$<br>$r_{1 \max a}$ | a                   |
| mm   |       | mm                         | mm                                       | mm                                      | mm                  |
| over | incl. |                            |  |   |                     |
| –    | 25    | <b>0,1</b>                 | 0,2                                      | 0,4                                     | 0,9                 |
| –    | 25    | <b>0,15</b>                | 0,3                                      | 0,6                                     | 1,1                 |
| –    | 40    | <b>0,2</b>                 | 0,5                                      | 0,8                                     | 1,3                 |
| –    | 40    | <b>0,3</b>                 | 0,6                                      | 1                                       | 1,5                 |
| 40   | 120   | <b>0,3</b>                 | 0,8                                      | 1                                       | 1,5                 |
| 120  | 250   | <b>0,3</b>                 | 1  | 1,7                                     | 2,2                 |
| –    | 40    | <b>0,6</b>                 | 1  | 2                                       | 2,5                 |
| 40   | 250   | <b>0,6</b>                 | 1,3                                      | 2                                       | 2,5                 |
| 250  | 400   | <b>0,6</b>                 | 1,5                                      | 2,6                                     | 3,1                 |
| –    | 50    | <b>1</b>                   | 1,5                                      | 3                                       | 3,6                 |
| 50   | 400   | <b>1</b>                   | 1,9                                      | 3                                       | 3,6                 |
| 400  | 500   | <b>1</b>                   | 2,5                                      | 3,5                                     | 4,2                 |
| –    | 120   | <b>1,1</b>                 | 2  | 3,5                                     | 4,2                 |
| 120  | 400   | <b>1,1</b>                 | 2,5                                      | 4                                       | 4,8                 |
| 400  | 500   | <b>1,1</b>                 | 2,7                                      | 4,5                                     | 5,4                 |
| –    | 120   | <b>1,5</b>                 | 2,3                                      | 4                                       | 4,8                 |
| 120  | 400   | <b>1,5</b>                 | 3  | 5                                       | 6                   |
| 400  | 800   | <b>1,5</b>                 | 3,5                                      | 5                                       | 6                   |
| –    | 80    | <b>2</b>                   | 3  | 4,5                                     | 5,4                 |
| 80   | 220   | <b>2</b>                   | 3,5                                      | 5                                       | 6                   |
| 220  | 800   | <b>2</b>                   | 3,8                                      | 6                                       | 7,2                 |
| –    | 280   | <b>2,1</b>                 | 4  | 6,5                                     | 7,8                 |
| 280  | 1200  | <b>2,1</b>                 | 4,5                                      | 7                                       | 8,4                 |
| –    | 100   | <b>2,5</b>                 | 3,8                                      | 6                                       | 7,2                 |
| 100  | 280   | <b>2,5</b>                 | 4,5                                      | 6                                       | 7,2                 |
| 280  | 800   | <b>2,5</b>                 | 5  | 7                                       | 8,4                 |
| 800  | 1200  | <b>2,5</b>                 | 5  | 7,5                                     | 9                   |
| –    | 280   | <b>3</b>                   | 5  | 8                                       | 9,6                 |
| 280  | 1200  | <b>3</b>                   | 5,5                                      | 8                                       | 9,6                 |
| –    | 1200  | <b>4</b>                   | 6,5                                      | 9                                       | 10,8                |
| –    | 2000  | <b>5</b>                   | 8  | 10                                      | 12                  |
| –    | 3000  | <b>6</b>                   | 10                                       | 13                                      | 15,6                |
| –    | 3000  | <b>7,5</b>                 | 12,5                                     | 17                                      | 20,4                |

# Tolerances

## Chamfer dimension of radial bearings with tapered bore

| Bore    |       | Chamfer dimension                |  |   | Measurement spacing<br>a<br>mm |
|---------|-------|----------------------------------|--|---|--------------------------------|
| d<br>mm |       | $r_{\min}$<br>$r_{1 \min}$<br>mm | radial<br>$r_{\max r}$<br>$r_{s \max r}$<br>mm | axial<br>$r_{\max a}$<br>$r_{1 \max a}$<br>mm |                                |
| over    | incl. |                                  |  |   |                                |
| –       | 25    | <b>0,05</b>                      | 0,15   | 0,25  | 0,8                            |
| –       | 25    | <b>0,1</b>                       | 0,3  | 0,5   | 1                              |
| –       | 40    | <b>0,1</b>                       | 0,3  | 0,5   | 1                              |
| –       | 40    | <b>0,15</b>                      | 0,45   | 0,75  | 1,3                            |
| 40      | 120   | <b>0,15</b>                      | 0,45   | 0,75  | 1,3                            |
| 120     | 250   | <b>0,2</b>                       | 0,6  | 1   | 1,5                            |
| –       | 40    | <b>0,25</b>                      | 0,75   | 1,25  | 1,8                            |
| 40      | 250   | <b>0,3</b>                       | 0,9  | 1,5   | 2                              |
| 250     | 400   | <b>0,35</b>                      | 1,05   | 1,75  | 2,3                            |
| –       | 50    | <b>0,4</b>                       | 1,2  | 2   | 2,5                            |
| 50      | 400   | <b>0,45</b>                      | 1,35   | 2,25  | 2,8                            |
| 400     | 500   | <b>0,5</b>                       | 1,5  | 2,5   | 3                              |
| –       | 120   | <b>0,5</b>                       | 1,5  | 2,5   | 3                              |
| 120     | 400   | <b>0,55</b>                      | 1,65   | 2,75  | 3,3                            |
| 400     | 500   | <b>0,6</b>                       | 1,8  | 3   | 3,5                            |
| –       | 120   | <b>0,6</b>                       | 1,8  | 3   | 3,5                            |
| 120     | 400   | <b>0,7</b>                       | 2,1  | 3,5   | 4,2                            |
| 400     | 800   | <b>0,7</b>                       | 2,1  | 3,5   | 4,2                            |
| –       | 80    | <b>0,7</b>                       | 2,1  | 3,5   | 4,2                            |
| 80      | 220   | <b>0,8</b>                       | 2,4  | 4   | 4,8                            |
| 220     | 800   | <b>0,9</b>                       | 2,7  | 4,5   | 5,4                            |
| –       | 280   | <b>0,9</b>                       | 2,7  | 4,5   | 5,4                            |
| 280     | 1200  | <b>1</b>                         | 3  | 5   | 6                              |
| –       | 100   | <b>0,9</b>                       | 2,7  | 4,5   | 5,4                            |
| 100     | 280   | <b>1</b>                         | 3  | 5   | 6                              |
| 280     | 800   | <b>1,1</b>                       | 3,3  | 5,5   | 6,6                            |
| 800     | 1200  | <b>1,1</b>                       | 3,3  | 5,5   | 6,6                            |
| –       | 280   | <b>1,2</b>                       | 3,6  | 6   | 7,2                            |
| 280     | 1200  | <b>1,2</b>                       | 3,6  | 6   | 7,2                            |
| –       | 1200  | <b>1,5</b>                       | 4,5  | 7,5   | 9                              |
| –       | 2000  | <b>1,8</b>                       | 5,5  | 9   | 10,8                           |
| –       | 3000  | <b>2,2</b>                       | 6,5  | 11  | 13,2                           |
| –       | 3000  | <b>3</b>                         | 9  | 15  | 18                             |



- ① Bore or outside diameter
- ② Lateral face

Figure 3  
Limit chamfer dimensions

**Chamfer dimension  
of axial bearings**

| Bore<br>d<br>mm |       | Chamfer dimension               |   |  | Measurement<br>spacing<br>a<br>mm |
|-----------------|-------|---------------------------------|---|--|-----------------------------------|
|                 |       | $r_{\min}$<br>$r_{1\min}$<br>mm | radial<br>$r_{\max r}$<br>$r_{s\max r}$<br>mm | axial<br>$r_{\max a}$<br>$r_{1\max a}$<br>mm |                                   |
| over            | incl. |                                 |   |  |                                   |
| –               | 25    | <b>0,1</b>                      | 0,2   | 0,2  | 0,7                               |
| –               | 25    | <b>0,15</b>                     | 0,3   | 0,3  | 0,8                               |
| –               | 40    | <b>0,2</b>                      | 0,5   | 0,5  | 1                                 |
| –               | 120   | –                               | 0,8   | 0,8  | 1,3                               |
| 120             | 250   | <b>0,3</b>                      | 1   | 1  | 1,5                               |
| –               | 400   | <b>0,6</b>                      | 1,5   | 1,5  | 2                                 |
| –               | 500   | –                               | 2,2   | 2,2  | 2,6                               |
| 500             | 800   | <b>1</b>                        | 2,6   | 2,6  | 3,1                               |
| –               | 800   | <b>1,1</b>                      | 2,7   | 2,7  | 3,2                               |
| –               | 1200  | <b>1,5</b>                      | 3,5   | 3,5  | 4,2                               |
| –               | 1200  | <b>2</b>                        | 4   | 4  | 4,8                               |
| –               | 1200  | <b>2,1</b>                      | 4,5   | 4,5  | 5,4                               |
| –               | 2000  | <b>3</b>                        | 5,5   | 5,5  | 6,6                               |
| –               | 2000  | <b>4</b>                        | 6,5   | 6,5  | 7,8                               |
| –               | 3000  | <b>5</b>                        | 8   | 8  | 9,6                               |
| –               | 3000  | <b>6</b>                        | 10  | 10   | 12                                |
| –               | 3000  | <b>7,5</b>                      | 12,5  | 12,5   | 15                                |

**Legend**

- $r_{\min}$ ,  $r_{1\min}$  mm  
Symbol for smallest chamfer dimension in radial and axial direction
- $r_{\max r}$ ,  $r_{1\max r}$  mm  
Largest chamfer dimension in radial direction
- $r_{\max a}$ ,  $r_{1\max a}$  mm  
Largest chamfer dimension in axial direction
- a mm  
Measurement spacing: this spacing is used for inspection of the bore or outside diameter tolerances.

# Tolerances

## Machining tolerances of adjacent parts

The performance capacity of super precision bearings in relation to speed suitability and running accuracy continues to increase. However, this increased performance capacity is only effective and can only be used to the full if the precision of the adjacent parts is in harmony with the precision of the bearings.

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. For spindle bearings, see page 47 and tables, page 55, for cylindrical roller bearings, see page 47 to 53, for axial angular contact ball bearings, see page 51.



The mean roughness values  $R_a$  of the bearing seats must not be exceeded, in order that the recommended fits remain within a restricted change (burnishing). 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 also be observed.

## Geometrical and positional tolerances of the shaft

- $d$  = nominal shaft diameter
- $d'$  = small taper diameter  
(=  $d$  + lower deviation, see table, page 48 and page 49)
- $d_1'$  = large taper diameter  
 $d_1' = d' + 1/12 \cdot L$
- $L$  = taper length  $L = 0,95 \cdot B$   
(bearing width)
- $t_1$  = cylindricity tolerance according to DIN ISO 1101
- $t_2$  = roundness tolerance according to DIN ISO 1101
- $t_3$  = flatness tolerance according to DIN ISO 1101
- $t_4$  = axial runout tolerance according to DIN ISO 1101
- $t_5$  = coaxiality tolerance according to DIN ISO 1101
- $AT_D$  = taper angle tolerance according to DIN 7178
- $R_a$  = mean roughness according to DIN ISO 4768

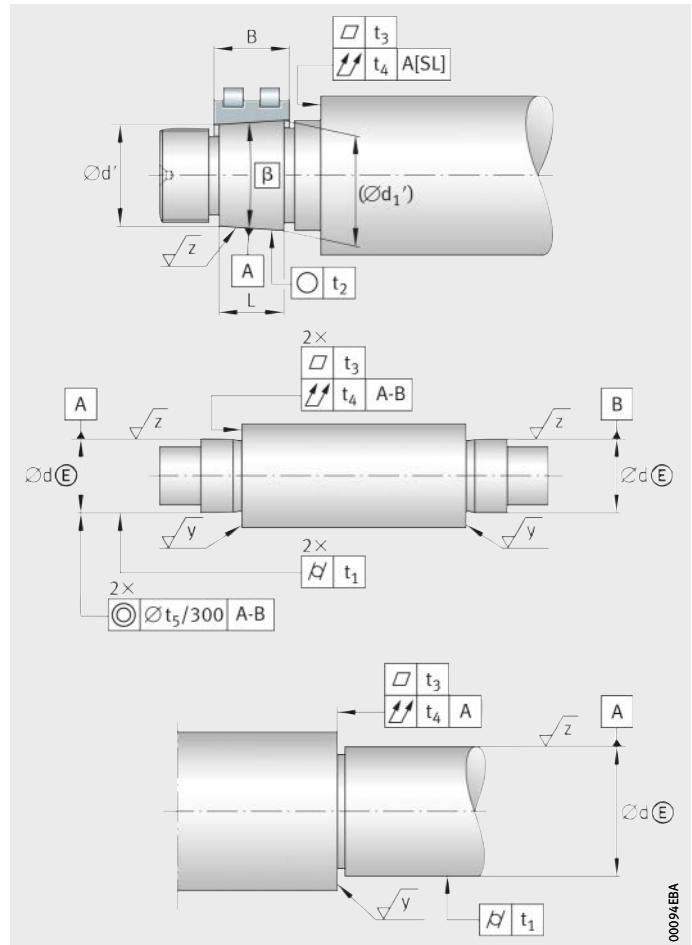


Figure 4  
Geometrical and positional tolerances of the shaft



## Spindle bearings and axial bearings BAX



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

Recommendations for the machining tolerances of the shaft are shown in the table.

### Machining tolerances of the shaft

| Nominal shaft diameter d mm |       | Deviation for d μm |      | Cylindricity μm | Flatness μm    | Axial runout μm | Coaxiality μm  | Mean roughness μm |
|-----------------------------|-------|--------------------|------|-----------------|----------------|-----------------|----------------|-------------------|
| over                        | incl. |                    |      | t <sub>1</sub>  | t <sub>3</sub> | t <sub>4</sub>  | t <sub>5</sub> | Ra                |
| -                           | 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               |

## Super precision cylindrical roller bearings



In order to make comprehensive use of the performance capacity of super precision cylindrical roller bearings, the adjacent construction must be of an appropriate design.

Recommendations for the machining tolerances of the cylindrical shaft (for super precision cylindrical roller bearings of tolerance class SP or UP) are shown in the tables.

### Tolerances of the cylindrical shaft for tolerance class SP

| Nominal shaft diameter d mm |       | Deviation for d μm |      | Cylindricity μm | Flatness μm    | Runout μm      | Coaxiality μm  | Mean roughness μm |
|-----------------------------|-------|--------------------|------|-----------------|----------------|----------------|----------------|-------------------|
| over                        | incl. |                    |      | t <sub>1</sub>  | t <sub>3</sub> | t <sub>4</sub> | t <sub>5</sub> | Ra                |
| 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               |

# Tolerances

## Tolerances of the cylindrical shaft for tolerance class UP

| Nominal shaft diameter d<br>mm |       | Deviation for d<br>μm |      | Cylin-<br>dricity<br>μm<br>t <sub>1</sub> | Flat-<br>ness<br>μm<br>t <sub>3</sub> | Runout<br>μm<br>t <sub>4</sub> | Coaxi-<br>ality<br>μm<br>t <sub>5</sub> | Mean<br>rough-<br>ness<br>μm<br>Ra |
|--------------------------------|-------|-----------------------|------|---|---------------------------------------|--------------------------------|---|------------------------------------|
| over                           | incl. |                       |      |   |                                       |                                |   |                                    |
| 18                             | 30    | 2                     | -2   | 0,6                                       | 0,6                                   | 1                              | 2,5                                     | 0,2                                |
| 30                             | 50    | 2                     | -2   | 0,6                                       | 0,6                                   | 1                              | 2,5                                     | 0,2                                |
| 50                             | 80    | 2,5                   | -2,5 | 0,8                                       | 0,8                                   | 1,2                            | 3                                       | 0,2                                |
| 80                             | 120   | 3                     | -3   | 1   | 1                                     | 1,5                            | 4                                       | 0,2                                |
| 120                            | 180   | 4                     | -4   | 1,2                                       | 1,2                                   | 2                              | 5                                       | 0,2                                |
| 180                            | 250   | 5                     | -5   | 2   | 2                                     | 3                              | 7                                       | 0,2                                |
| 250                            | 315   | 6                     | -6   | 2,5                                       | 2,5                                   | 4                              | 8                                       | 0,4                                |
| 315                            | 400   | 6,5                   | -6,5 | 3   | 3                                     | 5                              | 9                                       | 0,4                                |
| 400                            | 500   | 7,5                   | -7,5 | 4   | 4                                     | 6                              | 10                                      | 0,4                                |
| 500                            | 630   | 8                     | -8   | 5   | 5                                     | 7                              | 11                                      | 0,4                                |
| 630                            | 800   | 9                     | -9   | 5   | 5                                     | 8                              | 12                                      | 0,4                                |

Recommendations for the machining tolerances of the tapered shaft (for super precision cylindrical roller bearings of tolerance class SP or UP) are shown in the tables.

## Tolerances of the tapered shaft for tolerance class SP

| Nominal shaft diameter (bearing bore) d<br>mm |       | Deviation of small taper diameter <sup>1)</sup><br>μm |       | Round-<br>ness<br>μm<br>t <sub>2</sub> | Flat-<br>ness<br>μm<br>t <sub>3</sub> | Runout<br>μm<br>t <sub>4</sub> | Mean<br>rough-<br>ness<br>μm<br>Ra |
|---|-------|---|-------|--|---------------------------------------|--------------------------------|------------------------------------|
| 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                                |

<sup>1)</sup> In relation to the nominal shaft diameter d, see page 49.



## Tolerances of the tapered shaft for tolerance class UP

| Nominal shaft diameter (bearing bore)<br>d<br>mm |       | Deviation of small taper diameter <sup>1)</sup><br>μm |        | Roundness<br>μm<br>t <sub>2</sub> | Flatness<br>μm<br>t <sub>3</sub> | Runout<br>μm<br>t <sub>4</sub> | Mean roughness<br>μm<br>Ra |
|--|-------|---|--------|-----------------------------------|----------------------------------|--------------------------------|----------------------------|
| over   | incl. |   |        |                                   |                                  |                                |                            |
| 18   | 30    | +73   | +64    | 0,6                               | 0,6                              | 1                              | 0,2                        |
| 30   | 40    | +91   | +80    | 0,6                               | 0,6                              | 1                              | 0,2                        |
| 40   | 50    | +108  | +97    | 0,6                               | 0,6                              | 1                              | 0,2                        |
| 50   | 65    | +135  | +122   | 0,8                               | 0,8                              | 1,2                            | 0,2                        |
| 65   | 80    | +159  | +146   | 0,8                               | 0,8                              | 1,2                            | 0,2                        |
| 80   | 100   | +193  | +178   | 1                                 | 1                                | 1,5                            | 0,2                        |
| 100  | 120   | +225  | +210   | 1                                 | 1                                | 1,5                            | 0,2                        |
| 120  | 140   | +266  | +248   | 1,2                               | 1,2                              | 2                              | 0,2                        |
| 140  | 160   | +298  | +280   | 1,2                               | 1,2                              | 2                              | 0,2                        |
| 160  | 180   | +328  | +310   | 1,2                               | 1,2                              | 2                              | 0,2                        |
| 180  | 200   | +370  | +350   | 2                                 | 2                                | 3                              | 0,2                        |
| 200  | 225   | +405  | +385   | 2                                 | 2                                | 3                              | 0,2                        |
| 225  | 250   | +445  | +425   | 2                                 | 2                                | 3                              | 0,2                        |
| 250  | 280   | +498  | +475   | 2,5                               | 2,5                              | 4                              | 0,4                        |
| 280  | 315   | +548  | +525   | 2,5                               | 2,5                              | 4                              | 0,4                        |
| 315  | 355   | +615  | +590   | 3                                 | 3                                | 5                              | 0,4                        |
| 355  | 400   | +685  | +660   | 3                                 | 3                                | 5                              | 0,4                        |
| 400  | 450   | +767  | +740   | 4                                 | 4                                | 6                              | 0,4                        |
| 450  | 500   | +847  | +820   | 4                                 | 4                                | 6                              | 0,4                        |
| 500  | 560   | +928  | +900   | 5                                 | 5                                | 7                              | 0,4                        |
| 560  | 630   | +1 008  | +980   | 5                                 | 5                                | 7                              | 0,4                        |
| 630  | 710   | +1 092  | +1 060 | 5                                 | 5                                | 8                              | 0,4                        |

<sup>1)</sup> In relation to the nominal shaft diameter d, see section Calculation example.

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

Calculation 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 taper angle tolerance AT<sub>D</sub> applies vertical to the axis and is defined as the differential diameter.

When using FAG taper gauges MGK132, the AT<sub>D</sub> values stated should be halved (inclination angle tolerance).

For taper lengths with nominal dimensions between the values stated in the table, the taper angle tolerance AT<sub>D</sub> is determined by means of interpolation.

# Tolerances

The deviation of the taper angle of the shaft seat for super precision cylindrical roller bearings of tolerance class SP is shown in the table.

## Deviation of taper angle

| Nominal taper length<br>L<br>mm |                         | Taper angle tolerance<br>AT <sub>D</sub><br>μm |   |                  |   |
|---------------------------------|-------------------------|--|---|------------------|---|
| L <sub>U</sub><br>over          | L <sub>O</sub><br>incl. | AT <sub>DU</sub>                               |   | AT <sub>DO</sub> |   |
| 16                              | 25                      | +2   | 0 | +3,2             | 0 |
| 25                              | 40                      | +2,5   | 0 | +4               | 0 |
| 40                              | 63                      | +3,2   | 0 | +5               | 0 |
| 63                              | 100                     | +4   | 0 | +6,3             | 0 |
| 100                             | 160                     | +5   | 0 | +8               | 0 |
| 160                             | 250                     | +6,3   | 0 | +10              | 0 |

Calculation example of the taper length of a shaft seat 50 mm, tolerance class SP.

$$AT_D = \frac{AT_{DO} - AT_{DU}}{L_o - L_u} \cdot L$$

$$AT_D = \frac{5 - 3,2}{63 - 40} \cdot 50 = 3,91 \mu\text{m}$$

Taper angle tolerance AT<sub>D</sub> = +4 μm.





Axial angular contact ball bearings  
(2344)



In order to make comprehensive use of the performance capacity of double direction axial angular contact ball bearings, the adjacent construction must be of an appropriate design.

Recommendations for the machining tolerances of the shaft (for axial angular contact ball bearings of tolerance class SP or UP) are shown in the tables.

**Shaft design  
for tolerance class SP**

| Nominal shaft diameter<br>d<br>mm |       | Deviation for d<br>$\mu\text{m}$ |     | Cylin-<br>dricity<br>$\mu\text{m}$ | Flatness<br>$\mu\text{m}$ | Axial<br>runout<br>$\mu\text{m}$ | Mean rough-<br>ness<br>$\mu\text{m}$ |
|-----------------------------------|-------|----------------------------------|-----|------------------------------------|---------------------------|----------------------------------|--------------------------------------|
| over                              | incl. |                                  |     | $t_1$                              | $t_3$                     | $t_4$                            | Ra                                   |
| 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                                  |

**Shaft design  
for tolerance class UP**

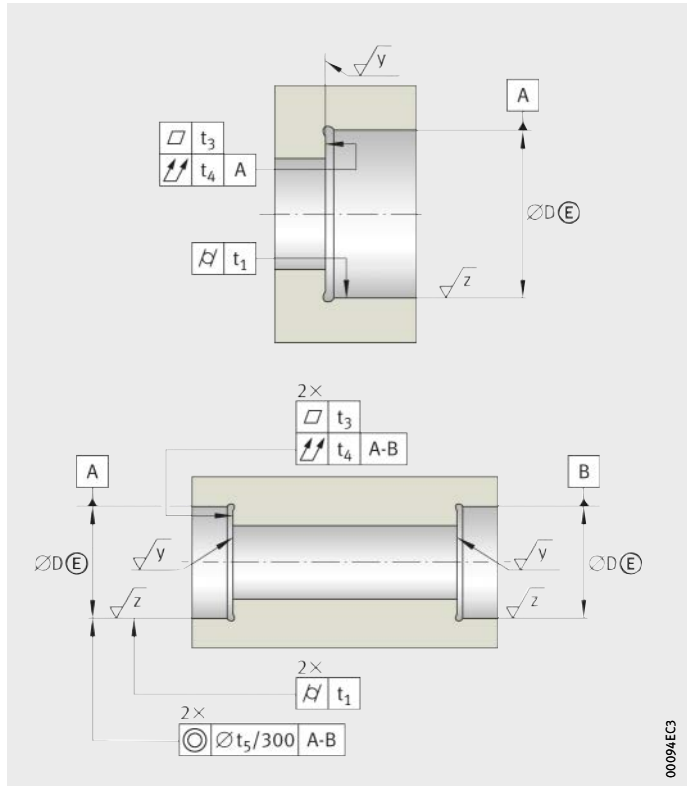
| Nominal shaft diameter<br>d<br>mm |       | Deviation for d<br>$\mu\text{m}$ |     | Cylin-<br>dricity<br>$\mu\text{m}$ | Flatness<br>$\mu\text{m}$ | Axial<br>runout<br>$\mu\text{m}$ | Mean rough-<br>ness<br>$\mu\text{m}$ |
|-----------------------------------|-------|----------------------------------|-----|------------------------------------|---------------------------|----------------------------------|--------------------------------------|
| over                              | incl. |                                  |     | $t_1$                              | $t_3$                     | $t_4$                            | Ra                                   |
| 18                                | 30    | 0                                | -4  | 0,6                                | 0,6                       | 1                                | 0,2                                  |
| 30                                | 50    | 0                                | -4  | 0,6                                | 0,6                       | 1                                | 0,2                                  |
| 50                                | 80    | 0                                | -5  | 0,8                                | 0,8                       | 1,2                              | 0,2                                  |
| 80                                | 120   | 0                                | -6  | 1                                  | 1                         | 1,5                              | 0,2                                  |
| 120                               | 180   | 0                                | -8  | 1,2                                | 1,2                       | 2                                | 0,2                                  |
| 180                               | 250   | 0                                | -10 | 2                                  | 2                         | 3                                | 0,2                                  |
| 250                               | 315   | 0                                | -12 | 2,5                                | 2,5                       | 4                                | 0,4                                  |
| 315                               | 400   | 0                                | -13 | 3                                  | 3                         | 5                                | 0,4                                  |
| 400                               | 500   | 0                                | -15 | 4                                  | 4                         | 6                                | 0,4                                  |

# Tolerances

## Geometrical and positional tolerances of the housing

- D = nominal housing bore diameter
- $t_1$  = cylindricity tolerance according to DIN ISO 1101
- $t_3$  = flatness tolerance according to DIN ISO 1101
- $t_4$  = axial runout tolerance according to DIN ISO 1101
- $t_5$  = coaxiality tolerance according to DIN ISO 1101
- Ra = mean roughness according to DIN ISO 4768

Figure 5  
Geometrical and positional tolerances of the housing



## Spindle bearings

Recommendations for the machining tolerance of the housing are shown in the table. The tolerances are matched to bearing tolerance class P4S.

## Tolerances of the housing

| Nominal housing bore diameter<br>D<br>mm |       | Deviation for D<br>$\mu\text{m}$ |    |                         |     | Cylin-<br>dric-<br>ity<br>$\mu\text{m}$ | Flat-<br>ness<br>$\mu\text{m}$ | Axial<br>runout<br>$\mu\text{m}$ | Coax-<br>iality<br>$\mu\text{m}$ | Mean<br>rough-<br>ness<br>$\mu\text{m}$ |
|--|-------|----------------------------------|----|-------------------------|-----|---|--------------------------------|----------------------------------|----------------------------------|---|
| over                                     | incl. | Locating<br>bearing              |    | Non-locating<br>bearing |     | $t_1$                                   | $t_3$                          | $t_4$                            | $t_5$                            | Ra                                      |
| 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                                     |



Super precision cylindrical roller bearings and axial angular contact ball bearings

Recommendations for the machining tolerances of the housing (for super precision cylindrical roller bearings and axial angular contact ball bearings (2344) of tolerance class SP or UP) are shown in the tables.

**Housing design for tolerance class SP**

| Nominal housing bore diameter<br>D<br>mm |       | Deviation for D<br>$\mu\text{m}$ |     | Cylindricity<br>$\mu\text{m}$<br>$t_1$ | Flatness<br>$\mu\text{m}$<br>$t_3$ | Axial runout<br>$\mu\text{m}$<br>$t_4$ | Coaxiality<br>$\mu\text{m}$<br>$t_5$ | Mean roughness<br>$\mu\text{m}$<br>Ra |
|--|-------|----------------------------------|-----|--|------------------------------------|--|--------------------------------------|---------------------------------------|
| 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                                   |

**Housing design for tolerance class UP**

| Nominal housing bore diameter<br>D<br>mm |       | Deviation for D<br>$\mu\text{m}$ |     | Cylindricity<br>$\mu\text{m}$<br>$t_1$ | Flatness<br>$\mu\text{m}$<br>$t_3$ | Axial runout<br>$\mu\text{m}$<br>$t_4$ | Coaxiality<br>$\mu\text{m}$<br>$t_5$ | Mean roughness<br>$\mu\text{m}$<br>Ra |
|--|-------|----------------------------------|-----|--|------------------------------------|--|--------------------------------------|---------------------------------------|
| over                                     | incl. |                                  |     |  |                                    |  |                                      |                                       |
| 30                                       | 50    | +1                               | -6  | 1                                      | 1                                  | 1,5                                    | 2,5                                  | 0,2                                   |
| 50                                       | 80    | +1                               | -7  | 1,2                                    | 1,2                                | 2                                      | 3                                    | 0,4                                   |
| 80                                       | 120   | +1                               | -9  | 1,5                                    | 1,5                                | 2,5                                    | 4                                    | 0,4                                   |
| 120                                      | 180   | +1                               | -11 | 2                                      | 2                                  | 3,5                                    | 5                                    | 0,4                                   |
| 180                                      | 250   | 0                                | -14 | 3                                      | 3                                  | 4,5                                    | 7                                    | 0,4                                   |
| 250                                      | 315   | 0                                | -16 | 4                                      | 4                                  | 6                                      | 8                                    | 0,8                                   |
| 315                                      | 400   | +1                               | -17 | 5                                      | 5                                  | 7                                      | 9                                    | 0,8                                   |
| 400                                      | 500   | 0                                | -20 | 6                                      | 6                                  | 8                                      | 10                                   | 0,8                                   |
| 500                                      | 630   | 0                                | -22 | 7                                      | 7                                  | 9                                      | 11                                   | 1,6                                   |
| 630                                      | 800   | 0                                | -24 | 8                                      | 8                                  | 10                                     | 12                                   | 1,6                                   |
| 800                                      | 1000  | 0                                | -27 | 9                                      | 9                                  | 11                                     | 14                                   | 1,6                                   |

Axial bearings BAX

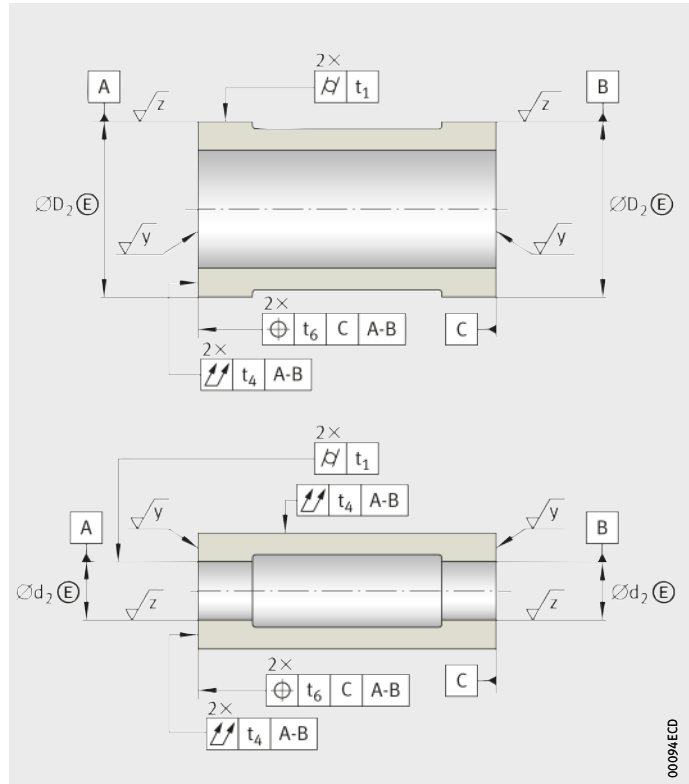
The machining tolerances of the housing are based on the cylindrical roller bearing used, see tables, page 53.

# Tolerances

## Geometrical and positional tolerances of spacer sleeves

- $d_2$  = nominal spacer sleeve bore diameter
- $D_2$  = nominal spacer sleeve outside diameter
- $t_1$  = cylindricity tolerance according to DIN ISO 1101
- $t_4$  = axial runout tolerance according to DIN ISO 1101
- $t_6$  = parallelism tolerance according to DIN ISO 1101
- $t_7$  = roundness tolerance according to DIN ISO 1101
- Ra = mean roughness according to DIN ISO 4768

*Figure 6*  
Geometrical and positional tolerances of spacer sleeves



Recommendations for the machining tolerances of the inner and outer spacer sleeve, see tables.

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.



### Tolerances of the inner spacer sleeve

| Nominal sleeve bore diameter<br>$d_2$<br>mm |       | Deviation for $d_2$<br>$\mu\text{m}$ |   | Cylin-<br>dricity<br>$\mu\text{m}$<br>$t_1$ | Axial<br>runout<br>$\mu\text{m}$<br>$t_4$ | Paral-<br>lelism<br>$\mu\text{m}$<br>$t_6$ | Radial<br>runout<br>$\mu\text{m}$<br>$t_7$ | Mean<br>rough-<br>ness <sup>1)</sup><br>$\mu\text{m}$<br>Ra |
|---|-------|--------------------------------------|---|---|---|--|--|---|
| 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   |

<sup>1)</sup> Including end faces.

### Tolerances of the outer spacer sleeve

| Nominal sleeve outside diameter<br>$D_2$<br>mm |       | Deviation for $D_2$<br>$\mu\text{m}$ |     | Cylin-<br>dricity<br>$\mu\text{m}$<br>$t_1$ | Axial<br>runout<br>$\mu\text{m}$<br>$t_4$ | Parallel-<br>ism<br>$\mu\text{m}$<br>$t_6$ | Mean<br>rough-<br>ness <sup>1)</sup><br>$\mu\text{m}$<br>Ra |
|--|-------|--------------------------------------|-----|---|---|--|---|
| 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   |

<sup>1)</sup> Including end faces.

# Tolerances

## Spindle bearings Fit as a function of speed

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  $2 \cdot 10^6$  mm/min and, in the case of oil lubrication, even  $3 \cdot 10^6$  mm/min 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.

### Calculation of the interference

This can be prevented by correspondingly tight fits on the shaft. The necessary interference can be taken from the diagram or calculated using BEARINX, *Figure 7*. The values calculated in this way will give a fit under which there will still be interference of  $1 \mu\text{m}$  at the highest speed.

The value  $f_w$  can be taken from the following diagrams.

For the bearing types B, HCB, RS and HCRS, see *Figure 8*, page 57.  
For the bearing types HS, HC and XC, see *Figure 9*, page 57.

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.



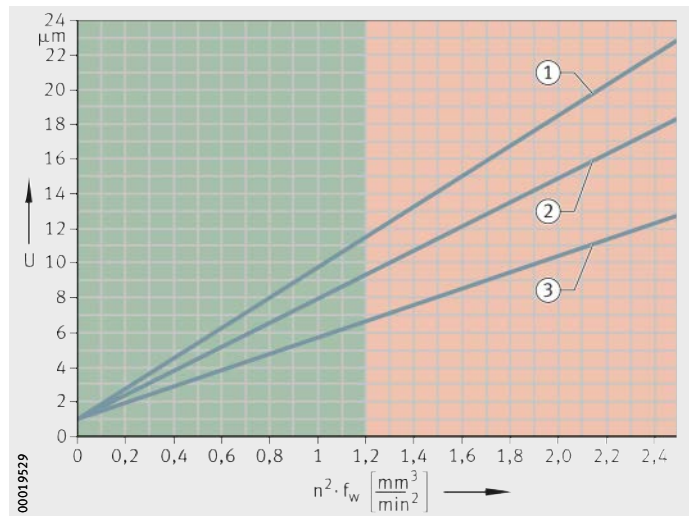
At values  $f_w \cdot n^2 > 1,2$  (red area), *Figure 7*, page 56, it is recommended that advice should be obtained from the Application Engineering facilities of the Schaeffler Group.

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%

*Figure 7*

Calculation of the interference between the shaft and inner ring





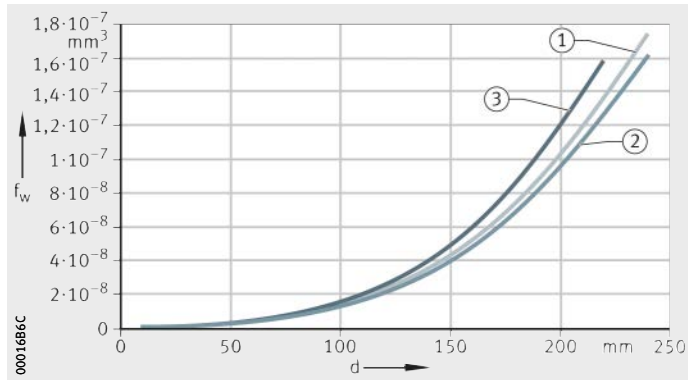
$f_w$  = factor for determining the fit between the inner ring and shaft, as a function of speed

$d$  = bearing bore

- ① B70, RS70, HCRS70
- ② B719, RS719, HCRS719
- ③ B72, HCB72

Figure 8

Factor  $f_w$  for B, HCB, RS, HCRS



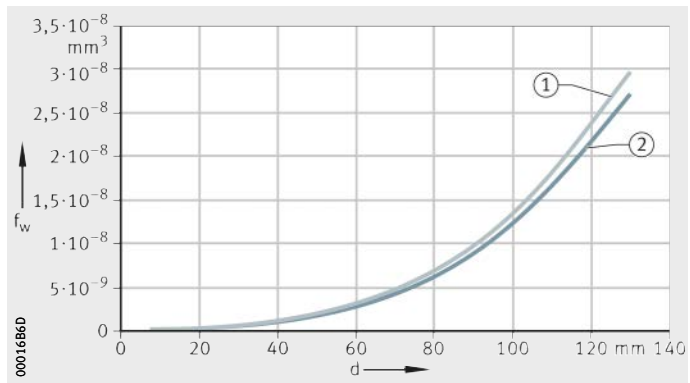
$f_w$  = factor for determining the fit between the inner ring and shaft, as a function of speed

$d$  = bearing bore

- ① HC70, HS70, XC70
- ② HC719, HS719, XC719

Figure 9

Factor  $f_w$  for HS, HC, XC



**Example**

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

Given data

- Spindle bearing
  - HCS71914-E-T-P4S-UL
- Speed  $n$ 
  - $16\,000\text{ min}^{-1}$
- Inner ring actual dimension (the deviation from the actual dimension is indicated on the bearing ring)
  - $70\text{ mm} - 3\text{ }\mu\text{m} = 69,997\text{ mm}$
- Bore of hollow shaft
  - $35\text{ mm}$  ( $\triangleq 50\%$  of bore diameter)
- Factor for determining the fit, as a function of the speed for bearing types HS, HC and XC, Figure 9, page 57
  - $f_w = 4,30 \cdot 10^{-9}$ .

Calculation

$$n^2 \cdot f_w = 1,1$$

With the value 1,1 and the curve ②, Figure 7, page 56, the necessary interference is calculated as  $9\text{ }\mu\text{m}$ .

The actual dimension of the shaft must thus be  $70,006\text{ mm}$ , in order that the inner ring is still firmly seated on the shaft at a speed of  $n = 16\,000\text{ min}^{-1}$ .

# Tolerances

## Super precision cylindrical roller bearings and axial bearings (2344)

### Radial internal clearance

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.

### Radial internal clearance of bearings with tapered bore

| Nominal bore diameter<br>d<br>mm |       | Internal clearance group |      |                        |      |                        |      |                        |      |
|----------------------------------|-------|--------------------------|------|------------------------|------|------------------------|------|------------------------|------|
|                                  |       | C1 <sup>1)</sup><br>μm   |      | C2 <sup>2)</sup><br>μm |      | CN <sup>2)</sup><br>μm |      | C3 <sup>2)</sup><br>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  |
| 220                              | 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  |

Radial internal clearance without measurement load.

- 1) Bearings of accuracy SP and UP have a radial internal clearance C1.  
The bearing rings are not interchangeable (NA).
- 2) The internal clearance groups C2, CN and C3 can be ordered using suffixes for the accuracy SP and UP.  
The bearing rings are interchangeable.





**Radial internal clearance  
of bearings with cylindrical bore**

| Nominal bore diameter<br>d<br>mm |       | Internal clearance group |      |                        |      |                        |      |                        |      |
|----------------------------------|-------|--------------------------|------|------------------------|------|------------------------|------|------------------------|------|
|                                  |       | C1 <sup>1)</sup><br>μm   |      | C2 <sup>2)</sup><br>μm |      | CN <sup>2)</sup><br>μm |      | C3 <sup>2)</sup><br>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  |
| 220                              | 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  |

Radial internal clearance without measurement load.

- 1) Bearing of accuracy SP and UP have a radial internal clearance C1.  
The bearing rings are not interchangeable (NA).
- 2) The internal clearance groups C2, CN and C3 can be ordered using suffixes for the accuracy SP and UP.  
The bearing rings are interchangeable.

# Speeds

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

The decisive factors are:

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

## Spindle bearings



The limiting speeds in the dimension tables are based on elastically preloaded single bearings and are guide values that may deviate up or down depending on the operating conditions. However, they give an indication of the speed capacity under relatively 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.

## Reduction factors

The speed limits stated are reduced in the case of bearings fitted with rigid preload or high preload (in order to achieve better rigidity of the spindle) as well as in bearing pairs and bearing groups. The speeds in the dimension tables must therefore be multiplied by reduction factors. The factors  $f_r$  to be used here are shown in the table.

### Speed reduction for spindle bearing sets

| Bearing arrangement                                    | Bearing preload |      |      |
|--|-----------------|------|------|
|  | L               | M    | H    |
|  | Factor $f_r$    |      |      |
| <b>Bearing spacing greater than twice bearing bore</b> |                 |      |      |
|  | 0,85            | 0,75 | 0,5  |
|  | 0,8             | 0,7  | 0,5  |
|  | 0,75            | 0,65 | 0,45 |
| <b>Bearing spacing 0 up to bearing bore</b>            |                 |      |      |
|  | 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 |



## Super precision cylindrical roller bearings

The limiting speeds  $n_G$  given in the dimension tables are valid for grease lubrication or 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. Guide values are shown in the table. Speeds  $n_G$  grease and  $n_G$  oil, see dimension tables.

### Achievable speeds

| Single row cylindrical roller bearings |   |
|--|---|
| Clearance or preload<br>$\mu\text{m}$  | Maximum achievable speed<br>$\text{min}^{-1}$ |
| -5 to 0                                | $<0,75 \cdot n_G$ grease                      |
| 0 (clearance-free)                     | $0,75$ to $1,0 \cdot n_G$ grease              |
| 0 to 5                                 | $1$ to $1,1 \cdot n_G$ grease                 |
| 0 to 5                                 | $1,0 \cdot n_G$ oil                           |
| Double row cylindrical roller bearings |   |
| Clearance or preload<br>$\mu\text{m}$  | Achievable speed<br>$\text{min}^{-1}$         |
| -5 to 0                                | $<0,50 \cdot n_G$ grease                      |
| $2 \cdot 10^{-8} \cdot d_M$            | $0,50$ to $0,75 \cdot n_G$ grease             |
| $4 \cdot 10^{-8} \cdot d_M$            | $0,75$ to $1,0 \cdot n_G$ grease              |
| $1 \cdot 10^{-7} \cdot d_M$            | $1,0 \cdot n_G$ oil                           |

$$d_M = (d + D)/2$$

These values are guide values for  $\Delta T$  up to 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.

## Axial angular contact ball bearings

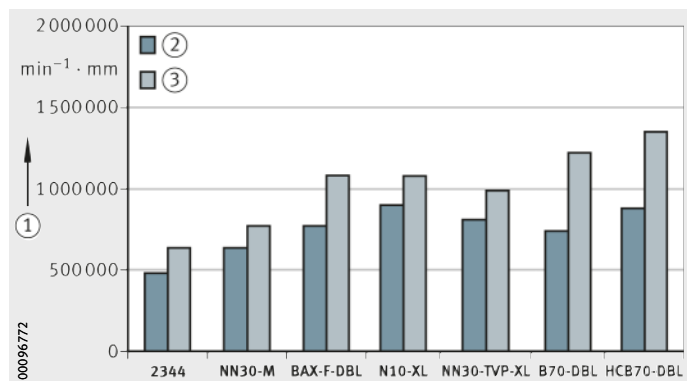
Double direction axial angular contact ball bearings are suitable for moderate speeds.

For higher speeds, single row angular contact ball bearings of the design BAX with a contact angle of  $30^\circ$  or optionally  $40^\circ$ , are available, see TPI 202, Axial Bearings BAX. These bearings are fitted in pairs and subjected to axial load only.

The speeds given in the dimension tables are valid for bearing pairs with light preload. The speed reduction factor for the preload M is 0,80.

- ① Speed parameter
- ② Grease lubrication
- ③ Minimal quantity oil lubrication

Figure 1  
Comparison of speed suitability



# 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.

## Axial rigidity

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






$$c_a = \frac{F_a}{\delta_a}$$

$c_a$  Axial rigidity N/ $\mu$ m  
 $F_a$  Axial force N  
 $\delta_a$  Axial displacement  $\mu$ m

Values for the axial rigidity, see dimension tables for spindle bearings, starting page 132, and for axial angular contact ball bearings, starting page 228.

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

### Axial rigidity of spindle bearing sets

| Bearing arrangement   | Axial rigidity $c_a$ <sup>1)</sup><br>N/ $\mu$ m | Lift-off force $K_{aE}$<br>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) Values, see dimension 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 dimension tables for the axial rigidity  $c_a$  are valid for bearing pairs in an O or X arrangement.

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  $\alpha = 15^\circ$
- $c_r \approx 3,5 \cdot c_a$  for  $\alpha = 20^\circ$
- $c_r \approx 2 \cdot c_a$  for  $\alpha = 25^\circ$ .

In sets with more than two bearings, there is an increase in the rigidity values and the lift-off force. The approximation values for the axial rigidity and lift-off force under a concentrically acting axial force are shown in the table Axial rigidity of spindle bearing sets.



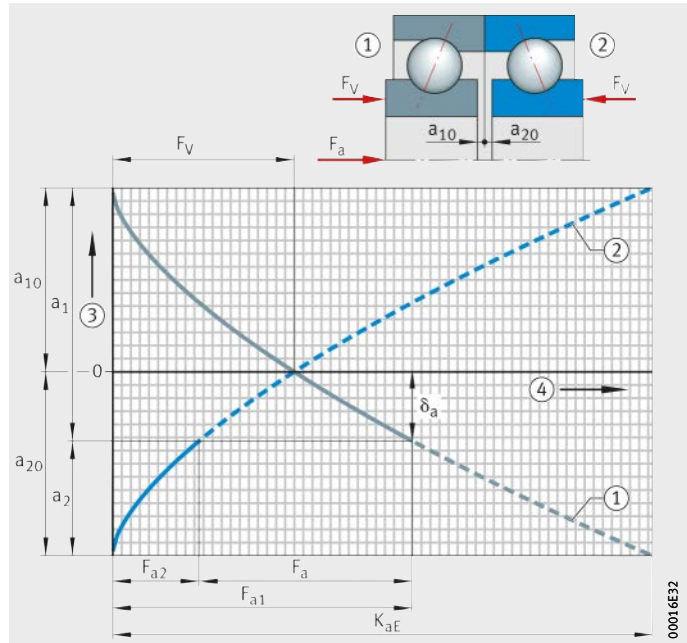
### Lift-off force

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, *Figure 1*.

- $F_V$  = 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

*Figure 1*  
Preload force,  
axial load, lift-off force



### Radial rigidity

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

- $c_r$  N/ $\mu$ m  
Radial rigidity, see dimension tables
- $F_r$  N  
Radial force
- $\delta_r$   $\mu$ m  
Radial displacement.

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 according to the following table.

### Radial rigidity of spindle bearing sets

| Bearing arrangement | Radial rigidity<br>$c_r$<br>N/ $\mu$ m |
|---------------------|--|
|                     | $c_r$                                  |
|                     | $1,36 \cdot c_r$                       |
|                     | $2 \cdot c_r$                          |
|                     | $1,6 \cdot c_r$                        |
|                     | $2,72 \cdot c_r$                       |

# Load carrying capacity and operating life

## 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 will 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, see also page 75.

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.

In practice, failure due to fatigue is not significant for these bearings. Calculation of the rating life  $L_{10}$  in accordance with DIN ISO 281 is therefore not an appropriate means of determining the operating life. If the load ratio of super precision cylindrical roller bearings is  $S_0^* \geq 8$ , this fulfils the essential precondition for fatigue strength.

## Fatigue strength

In order to check fatigue strength, the load ratio  $S_0^*$  is calculated in accordance with the following equation:

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

$S_0^*$  – Load ratio for fatigue strength (dynamic load safety factor)

$C_0$  – N Basic static load rating

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

The minimum value for the load ratio  $S_0^*$  at which the essential precondition for fatigue strength is fulfilled is dependent on the bearing type and the material used for the components, see table.

## Load ratio $S_0^*$

| Bearing type | Contact angle $\alpha = 15^\circ$ |                                | Contact angle $\alpha = 20^\circ$ |                                | Contact angle $\alpha = 25^\circ$ |                                |
|--------------|-----------------------------------|--------------------------------|-----------------------------------|--------------------------------|-----------------------------------|--------------------------------|
|              | $\frac{F_{0a}}{F_{0r}} \leq 1,09$ | $\frac{F_{0a}}{F_{0r}} > 1,09$ | $\frac{F_{0a}}{F_{0r}} \leq 1,20$ | $\frac{F_{0a}}{F_{0r}} > 1,09$ | $\frac{F_{0a}}{F_{0r}} \leq 1,30$ | $\frac{F_{0a}}{F_{0r}} > 1,30$ |
| B/HCB        | 8                                 | 12                             | –                                 | –                              | 8                                 | 10                             |
| HS/HC        | 8                                 | 12                             | –                                 | –                              | 8                                 | 10                             |
| RS/HCRS      | –                                 | –                              | 8                                 | 11                             | –                                 | –                              |
| XC           | 3                                 | 4                              | –                                 | –                              | 3                                 | 4                              |

A more precise method is individual calculation of the Hertzian pressures, see table, page 85, and checking of the bearing kinematics using a calculation program, see page 86.



If the other preconditions for an effective separating lubricant film (viscosity ratio  $\kappa \geq 2$ ) and very high cleanliness are fulfilled, calculation of the rating life is not necessary.

If these preconditions are not fulfilled, 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 or in accordance with DIN ISO 281 Appendix 4 for computer-aided methods.

## 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  $S_0$ .

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

$S_0$  – Static load safety factor

$C_0$  N Basic static load rating

$P_0$  N Equivalent dynamic bearing load for combined load,

see section Equivalent static bearing load.



In order 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,  $S_0 \geq 1$  is only possible with an extremely short-lived and concentrically acting axial load (tool ejection force)
- super precision cylindrical roller bearings:  $S_0 > 3$
- axial angular contact ball bearings:  $S_0 > 2,5$
- axial bearings BAX:  $S_0 > 2$ .

## 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.

# Load carrying capacity and operating life

## Spindle bearings

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

For bearings under static loading, the following applies:

### Spindle bearings with contact angle 15°

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

### Spindle bearings with contact angle 20°

| Load ratio                       | Equivalent static load                       |
|----------------------------------|--|
| $\frac{F_{0a}}{F_{0r}} \leq 1,2$ | $P_0 = F_{0r}$                               |
| $\frac{F_{0a}}{F_{0r}} > 1,2$    | $P_0 = 0,5 \cdot F_{0r} + 0,42 \cdot F_{0a}$ |

### 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

Axial static bearing load

$F_{0r}$  N

Radial static bearing load

$P_0$  N

Equivalent static bearing load for combined load.

## Super precision cylindrical roller bearings

Super precision cylindrical roller bearings can support radial forces only.

For bearings under static loading, the following applies:

$$P_0 = F_{0r}$$

$P_0$  N

Equivalent static bearing load

$F_{0r}$  N

Radial static bearing load.

## Axial angular contact ball bearings

Axial angular contact ball bearings can support axial forces only.

For bearings under static loading, the following applies:

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

$P_{0a}$  N

Equivalent static bearing load

$F_{0a}$  N

Axial static bearing load.





**Axial bearings BAX**

Axial bearings BAX can support axial forces only.

For bearings under static loading, the following applies:  $P_0 = F_a$ .

**Contact angle**

| Description                     | Load  | Equivalent static load |
|---------------------------------|-------|------------------------|
| Bearings with contact angle 30° | $F_a$ | $P_0 = 0,33 \cdot F_a$ |
| Bearings with contact angle 40° | $F_a$ | $P_0 = 0,26 \cdot F_a$ |

$F_a$  N

Axial bearing load

$P_0$  N

Equivalent static bearing load for combined load.

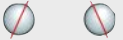
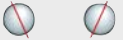
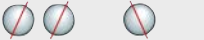
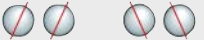


**Distribution of load over several bearings**

Where there are several bearings at one bearing position, the external load is distributed over the individual bearings, see table. 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.

**Distribution of load**

| Arrangement   | Proportion of load on most heavily loaded bearing |         |
|---|---|---------|
|   | $F_a$ %   | $F_r$ % |
|    | 100   | 60      |
|    | 100   | 60      |
|  | 50  | 60      |
|  | 50  | 60      |
|  | 33  | 60      |
|  | 33  | 60      |

# Lubrication

## 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. An essential precondition here is the formation of a lubricant film that separates the rolling contact partners at their contact points.

In order to achieve this:

- It must be ensured that lubricant is present at all contact points and at all times.
- The lubrication method defined must be appropriate to the required speed.
- A lubricant with the correct characteristics must be selected.

## 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, grease lubrication and minimal quantity oil lubrication, see dimension tables. 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, see table, page 60.

## Criteria for grease lubrication

Grease lubrication is predominantly used for super precision bearings.

This is a simple means of providing advantages such as:

- low friction
- lubrication “for life”
- very little design work required
- low system costs.

## Criteria for oil lubrication

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, *Figure 3*, page 75.

## 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 a spindle running at high speed, are particularly important for the temperature and running-in behaviour.

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.



## Lubricant viscosity

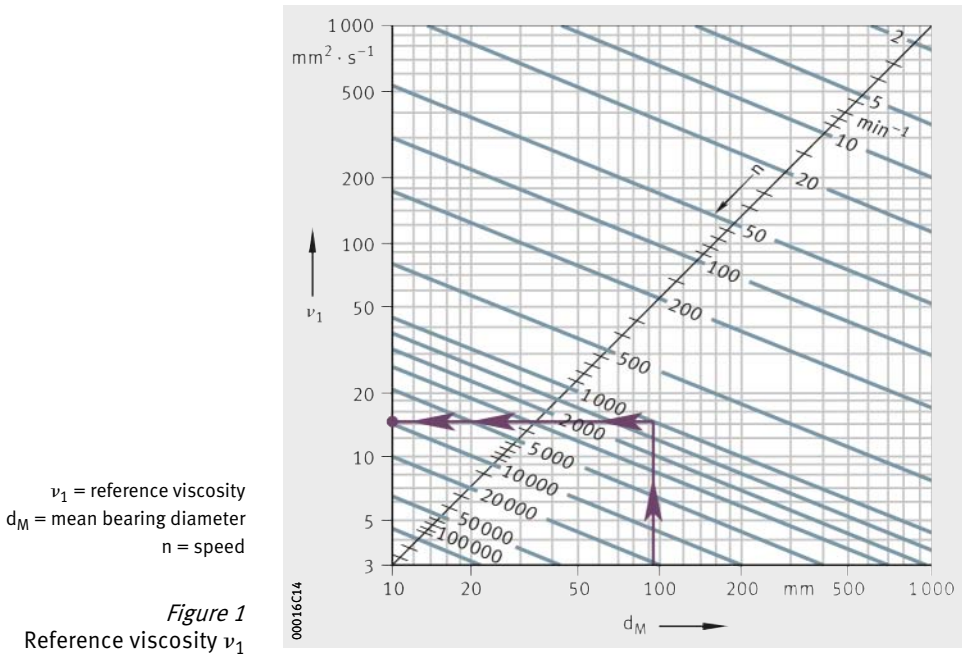
The condition of the lubricant film is determined by the viscosity ratio  $\kappa$ , which is defined as the quotient of the operating viscosity  $\nu$  and the reference viscosity  $\nu_1$ .

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

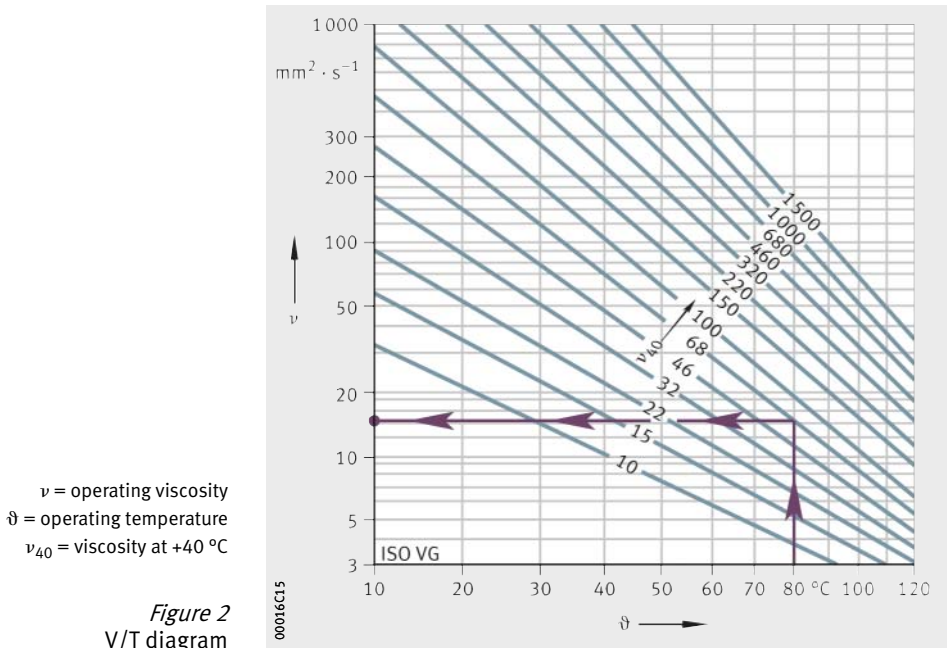
$\kappa$  —  
 Viscosity ratio  
 $\nu$   $\text{mm}^2 \cdot \text{s}^{-1}$   
 Kinematic viscosity of the lubricant at operating temperature  
 $\nu_1$   $\text{mm}^2 \cdot \text{s}^{-1}$   
 Reference viscosity of the lubricant at operating temperature.  
 The reference viscosity  $\nu_1$  is a function of the bearing size and speed.  
 Calculation of the value: *Figure 1.*

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, *Figure 2*, page 70.

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.



# Lubrication



## 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  $2\,000\,000 \text{ min}^{-1} \cdot \text{mm}$ .

The use of spindle bearings already greased “for life” and sealed brings further advantages, such as very high cleanliness, since the interior of the bearing is protected. It also gives simplified mounting.



## Greases with special suitability

Many of the rolling bearings supplied by Schaeffler Technologies have a grease filling. In mechanical-dynamic tests, the greases used have proved particularly suitable for the application. An overview of suitable FAG greases for super precision bearings is shown in the table.

### Greases for super precision bearings

| 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                      |
|  | +100 °C           | 5                    | 12,5                    |
| NLGI class   | 2 to 3            | 2                    | 3                       |
| Maximum operating temperature <sup>1)</sup> °C                     | 80                | 80                   | 110                     |
| Speed parameter $n \cdot d_M$ <sup>2)</sup> min <sup>-1</sup> · mm | 2 000 000         | 800 000              | 1 300 000               |
| Specific mass ≈g/cm <sup>3</sup>                                   | 0,94              | 0,9                  | 0,86                    |
| Application as   | high speed grease | high pressure grease | high temperature grease |

<sup>1)</sup> Without minimisation of service life.

<sup>2)</sup> 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 FAG 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.

**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.

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

### Standard greasing

In the case of sealed bearings supplied with standard greasing, the grease grade is not stated on the packaging or on the bearing. Open bearings supplied greased with high speed grease are identical by the application-oriented grease group GA21 on the bearing and on the packaging. In the case of these bearings, Schaeffler Technologies 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.

# Lubrication

## 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, see tables. Guidelines on greasing, see page 95.

### Recommended grease quantities for spindle bearings

| Bore code | Bearing series                     |                      |                                    |                                      |              |
|-----------|------------------------------------|----------------------|------------------------------------|--------------------------------------|--------------|
|           | Grease quantity<br>cm <sup>3</sup> |                      |                                    |                                      |              |
|           | HS719<br>HC719<br>XC719            | HS70<br>HC70<br>XC70 | B719<br>HCB719<br>RS719<br>HCRS719 | B70<br>HCB70<br>RS70<br>HCRS70<br>FD | B72<br>HCB72 |
| 6         | –                                  | 0,12                 | –                                  | 0,04                                 | –            |
| 7         | –                                  | 0,13                 | –                                  | 0,06                                 | –            |
| 8         | –                                  | 0,17                 | –                                  | 0,11                                 | –            |
| 9         | –                                  | 0,21                 | –                                  | 0,10                                 | –            |
| 00        | 0,17                               | 0,26                 | 0,09                               | 0,17                                 | 0,26         |
| 01        | 0,18                               | 0,28                 | 0,10                               | 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                 | 0,40                               | 0,86                                 | 1,44         |
| 06        | 0,92                               | 1,72                 | 0,42                               | 1,12                                 | 2,10         |
| 07        | 1,18                               | 2,20                 | 0,64                               | 1,74                                 | 3,00         |
| 08        | 1,62                               | 2,60                 | 1,36                               | 2,35                                 | 3,80         |
| 09        | 2,10                               | 3,65                 | 1,60                               | 3,00                                 | 4,55         |
| 10        | 2,35                               | 4,00                 | 1,74                               | 3,30                                 | 5,45         |
| 11        | 3,40                               | 5,95                 | 2,20                               | 4,60                                 | 6,50         |
| 12        | 3,60                               | 6,40                 | 2,50                               | 4,95                                 | 8,00         |
| 13        | 3,90                               | 6,80                 | 2,65                               | 5,30                                 | 9,35         |
| 14        | 5,80                               | 9,20                 | 4,35                               | 7,10                                 | 10,80        |
| 15        | 6,10                               | 9,70                 | 4,60                               | 7,50                                 | 12,90        |
| 16        | 7,00                               | 12,80                | 4,90                               | 9,65                                 | 12,30        |
| 17        | 8,55                               | 13,40                | 6,80                               | 10,30                                | 18,30        |
| 18        | 9,40                               | 17,70                | 7,10                               | 13,30                                | 19,10        |
| 19        | 9,85                               | 18,40                | 7,45                               | 13,90                                | 26,10        |
| 20        | 12,80                              | 19,20                | 9,70                               | 14,60                                | 27,20        |
| 21        | 13,30                              | 24,60                | 10,10                              | 15,00                                | 36,30        |
| 22        | 14,70                              | 28,20                | 10,40                              | 21,90                                | 43,90        |
| 24        | 17,90                              | 30,30                | 14,20                              | 23,60                                | 38,80        |
| 26        | 24,00                              | 43,70                | 18,10                              | 36,10                                | 41,90        |
| 28        | 25,60                              | 46,30                | 19,30                              | 38,30                                | 58,60        |
| 30        | 37,80                              | 57,10                | 28,40                              | 44,70                                | 81,30        |
| 32        | 39,90                              | 69,70                | 30,00                              | 58,20                                | 102,90       |
| 34        | –                                  | –                    | 31,70                              | 65,30                                | 120,40       |
| 36        | –                                  | –                    | 47,40                              | 94,90                                | 125,70       |
| 38        | –                                  | –                    | 50,00                              | 99,10                                | 155,40       |

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

The spindle bearings B719, B70 and some bearings of series B72 are also available greased and sealed, design 2RSD, see dimension tables.



**Recommended grease quantities  
for spindle bearings  
(continued)**

| Bore code | Bearing series<br>Grease quantity<br>cm <sup>3</sup> |                      |                                    |                                      |              |
|-----------|--|----------------------|------------------------------------|--------------------------------------|--------------|
|           | HS719<br>HC719<br>XC719                              | HS70<br>HC70<br>XC70 | B719<br>HCB719<br>RS719<br>HCRS719 | B70<br>HCB70<br>RS70<br>HCRS70<br>FD | B72<br>HCB72 |
| 40        | –  | –                    | 70,60                              | 118,30                               | 187,80       |
| 44        | –  | –                    | 68,30                              | 172,60                               | 250,10       |
| 48        | –  | –                    | 73,70                              | 185,30                               | –            |
| 52        | –  | –                    | 118,20                             | 267,00                               | –            |
| 56        | –  | –                    | 126,00                             | 283,90                               | –            |
| 60        | –  | –                    | 204,50                             | –                                    | –            |

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

The spindle bearings B719, B70 and some bearings of series B72 are also available greased and sealed, design 2RSD, see dimension tables.

**Recommended grease quantities  
for cylindrical roller bearings**

| Bore code | Bearing series<br>Grease quantity<br>cm <sup>3</sup> |       |       |       |
|-----------|--|-------|-------|-------|
|           | N10  | N19   | NN30  | NNU49 |
| 06        | 0,69   | –     | 0,76  | –     |
| 07        | 0,91   | –     | 0,95  | –     |
| 08        | 1,15   | –     | 1,14  | –     |
| 09        | 1,44   | –     | 1,61  | –     |
| 10        | 1,56   | 0,81  | 1,74  | –     |
| 11        | 2,25   | 1,05  | 2,55  | –     |
| 12        | 2,45   | 1,13  | 2,70  | –     |
| 13        | 2,60   | 1,20  | 2,85  | –     |
| 14        | 3,10   | 2,05  | 4,20  | 2,90  |
| 15        | 3,30   | 2,20  | 4,45  | 3,10  |
| 16        | 4,30   | 2,30  | 6,10  | 3,25  |
| 17        | 4,50   | 3,15  | 6,40  | 4,50  |
| 18        | 5,75   | 3,30  | 7,85  | 4,75  |
| 19        | 6,00   | 3,45  | 8,20  | 4,95  |
| 20        | 6,20   | 4,05  | 8,50  | 6,25  |
| 21        | 7,75   | 4,25  | 10,60 | 6,50  |
| 22        | 8,50   | 4,45  | 13,70 | 6,75  |
| 24        | 9,05   | 5,85  | 15,90 | 10,10 |
| 26        | 14,90  | 7,65  | 21,20 | 13,60 |
| 28        | 15,70  | 8,05  | 24,10 | 12,10 |
| 30        | 19,00  | 12,00 | 29,30 | 21,20 |
| 32        | 23,00  | 12,60 | 37,20 | 22,40 |
| 34        | 30,80  | 13,30 | 48,80 | 23,60 |
| 36        | 38,30  | 19,10 | 63,50 | 32,70 |
| 38        | 55,80  | 20,00 | 67,40 | 34,20 |

# Lubrication

## Recommended grease quantities for cylindrical roller bearings (continued)

| Bore code | Bearing series<br>Grease quantity<br>cm <sup>3</sup> |       |        |        |
|-----------|--|-------|--------|--------|
|           | N10  | N19   | NN30   | NNU49  |
| 40        | 67,90  | 29,70 | 86,70  | 54,50  |
| 44        | 72,50  | 32,10 | 110,10 | 59,00  |
| 48        | 112,50   | 34,50 | 127,50 | 63,60  |
| 52        | 119,10   | 52,60 | 177,30 | 109,50 |
| 56        | 157,70   | 55,90 | 196,70 | 116,60 |

Grease quantities only valid for greases in accordance with GA21:

## Recommended grease quantities for axial bearings BAX with TPA cage and double direction axial angular contact ball bearings

| Bore code | Bore diameter<br>mm | Bearing series<br>Grease quantity<br>cm <sup>3</sup> |        |
|-----------|---------------------|--|--------|
|           |                     | BAX  | 2344   |
| 06        | 30                  | –  | 3,90   |
| 07        | 35                  | –  | 5,00   |
| 08        | 40                  | –  | 6,10   |
| 09        | 45                  | –  | 7,80   |
| 10        | 50                  | 3,26   | 8,35   |
| 11        | 55                  | 4,84   | 12,20  |
| 12        | 60                  | 5,22   | 12,20  |
| 13        | 65                  | 5,6  | 13,30  |
| 14        | 70                  | 7,34   | 17,80  |
| 15        | 75                  | 7,78   | 18,90  |
| 16        | 80                  | 10,76  | 25,60  |
| 17        | 85                  | 11,3   | 27,80  |
| 18        | 90                  | 14,14  | 38,90  |
| 19        | 95                  | 15,1   | 38,90  |
| 20        | 100                 | 15,76  | 44,40  |
| 21        | 105                 | 21,1   | 61,10  |
| 22        | 110                 | 26,3   | 61,10  |
| 24        | 120                 | 28,35  | 66,70  |
| 26        | 130                 | 41,5   | 105,60 |
| 28        | 140                 | 44,25  | 116,70 |
| 30        | 150                 | 54,7   | 138,90 |
| 32        | 160                 | 68,2   | 172,20 |
| 34        | 170                 | 92,3   | 227,80 |
| 36        | 180                 | 119  | 316,70 |
| 38        | 190                 | 124,6  | 311,10 |
| 40        | 200                 | 166,3  | 411,10 |
| 44        | 220                 | –  | 522,20 |
| 48        | 240                 | –  | 622,20 |
| 52        | 260                 | –  | 833,30 |
| 56        | 280                 | –  | 850,00 |





## Grease operating life

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

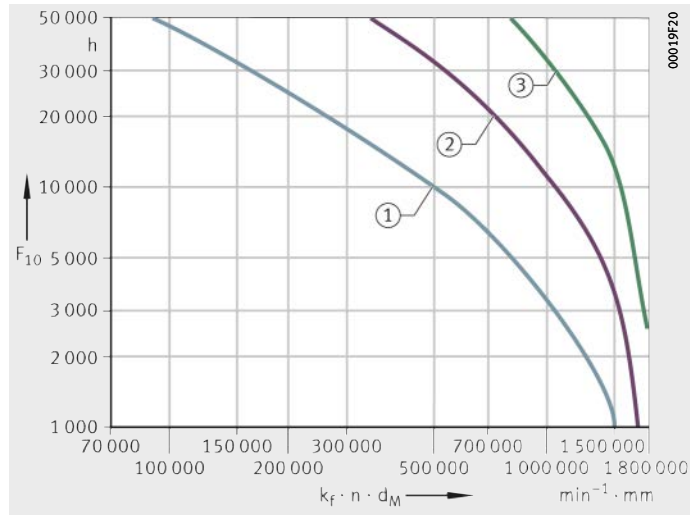
It is dependent on the following factors:

- the grease quantity
- the grease type
- the bearing type
- the speed
- the temperature
- the mounting, operating and 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  $k_f \cdot n \cdot d_M$ , *Figure 3*.

- $F_{10}$  = 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 Cronidur bearing



*Figure 3*  
Grease operating life  $F_{10}$

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

| Bearing type   |            | Factor $k_f$ |
|--|------------|--------------|
| Spindle bearings with contact angle                  | 15°        | 0,75         |
|  | 20°        | 0,8          |
|  | 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.

# Lubrication

Where operation is at varying speeds for known time periods, the total grease operating life can be calculated according to the following formula:

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

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



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

## 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 mounted 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.

## Running-in process

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

Recommendations for the grease distribution cycle of super precision bearings, *Figure 4*.

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.



- 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

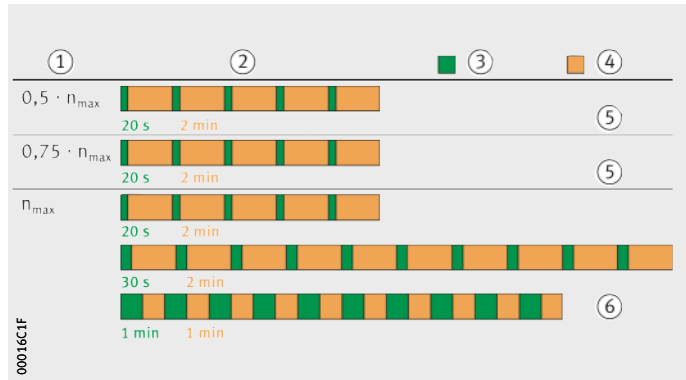


Figure 4  
Grease distribution cycle for open and sealed spindle bearings

### 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<sup>2</sup>/s at +40 °C and Extreme Pressure additives.

### Lubrication methods

#### Minimal quantity oil lubrication

Lubrication of FAG spindle bearings requires very little oil. Quantities of the order of magnitude of approx. 100 mm<sup>3</sup>/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. Speeds achieved with minimal quantity lubrication, see dimension tables.

Guide values for the oil quantity in pneumatic oil lubrication are shown in Figure 5. 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.

Oil quantities for super precision cylindrical roller bearings with pneumatic oil lubrication are shown in Figure 6, page 78.

Q = oil quantity  
d = bearing bore

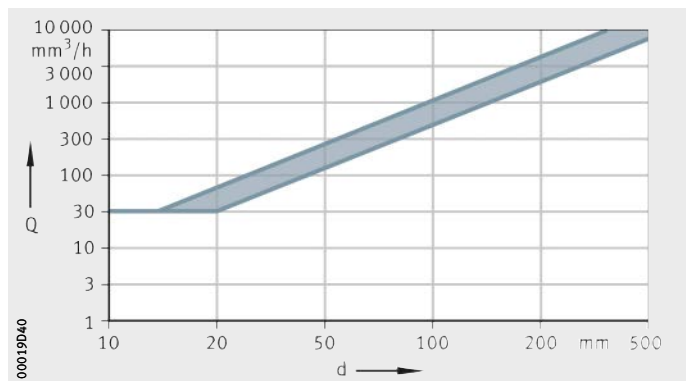


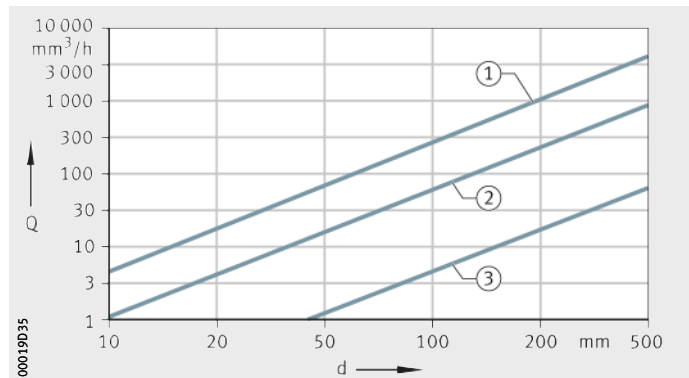
Figure 5  
Oil quantity for spindle bearings with pneumatic oil lubrication

# Lubrication

- Q = oil quantity  
d = bearing bore
- ① Oil quantity for cylindrical roller bearings with ceramic rollers and ribs on inner ring
  - ② Bearing with ribs on inner ring and  $n \cdot d_M \leq 10^6 \text{ min}^{-1} \cdot \text{mm}$
  - ③ Bearing with ribs on outer ring and  $n \cdot d_M \leq 600\,000 \text{ min}^{-1} \cdot \text{mm}$

Figure 6

Oil quantity for cylindrical roller bearings with pneumatic oil lubrication



Spindle bearings B, HCB, HS, HC, XC, RS and HCRS are also available in the Direct Lube design.

## Recommendations for pneumatic oil lubrication

| Feature                       | Recommendation                     |
|-------------------------------|------------------------------------|
| Air cleanliness               | Particle size max. 1 $\mu\text{m}$ |
| Dryness of air                | Dew point at +2 $^{\circ}\text{C}$ |
| Air pressure in the feed pipe | $\approx 3 \text{ bar}$            |

### Nozzle design

- Recommendation for nozzle diameter = 0,5 mm to 1 mm
- Provide 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.

### Injection pitch circle diameter

- Injection pitch circle diameter  $E_{tk}$ , see dimension tables
- In cylindrical roller bearings with a PVPA1 cage, there are two injection pitch circle diameters, depending on the injection side, see page 196.

### 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. five turns
- Centre axis horizontal or inclined at an angle up to 30 $^{\circ}$
- 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. Diameter of outlet hole preferably  $\geq 5 \text{ mm}$ .
- All outlet holes from all bearings on one spindle must be linked to each other in order to equalise pressures.

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



### Pneumatic oil lubrication devices

| Oil quantities per injection cycle<br>mm <sup>3</sup> | Injection cycles per hour |
|---|---------------------------|
| 3, 5, 10, (30, 60, 100)                               | 6 to 10 times             |

### 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.

### Recommended oil purity classes with point contact

| (D - d)/2<br>mm       | Requisite oil purity class in accordance with ISO 4406 | Requisite filter retention rate in accordance with ISO 4572 | Maximum size of overrolled particles <sup>1)</sup><br>µm |
|-----------------------|--|---|--|
| incl. 12,5            | 11/8   | $\beta_3 \geq 200$  | 10   |
| over 12,5<br>incl. 20 | 12/9   | $\beta_3 \geq 200$  | 15   |
| over 20<br>incl. 35   | 13/10  | $\beta_3 \geq 75$   | 25   |
| over 35               | 14/11  | $\beta_3 \geq 75$   | 40   |

<sup>1)</sup> The data are correct if, in the heavily loaded raceway area, no large particles with a hardness > 50 HRC are overrolled.

### Recommended oil purity classes with line contact

| (D - d)/2<br>mm       | Requisite oil purity class in accordance with ISO 4406 | Requisite filter retention rate in accordance with ISO 4572 | Maximum size of overrolled particles<br>µm |
|-----------------------|--|---|--|
| incl. 12,5            | 12/9   | $\beta_3 \geq 200$  | 20   |
| over 12,5<br>incl. 20 | 13/10  | $\beta_3 \geq 75$   | 25   |
| over 20<br>incl. 35   | 14/11  | $\beta_3 \geq 75$   | 40   |
| over 35               | 14/11  | $\beta_3 \geq 75$   | 75   |

The oil purity class as an indicator of the probability of overrolling by life-reducing particles in the bearing can be determined using specimens, 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 the filter in the so-called multi-pass test.



Filters coarser than  $\beta_3 \geq 75$  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.

## Operating temperature

### **Spindle bearings**

Spindle bearings are suitable for operating temperatures of  $-30\text{ °C}$  to  $+100\text{ °C}$ , restricted by the lubricant as well as the seal and cage material.

The FAG high performance grease for sealed spindle bearings is suitable up to a continuous temperature of  $+80\text{ °C}$ .

### **Super precision cylindrical roller bearings**

The bearings can be used at operating temperatures of  $-30\text{ °C}$  to  $+100\text{ °C}$  (or higher depending on the cage design).

### **Axial angular contact ball bearings**

Axial angular contact ball bearings can be used at operating temperatures of  $-30\text{ °C}$  to  $+100\text{ °C}$  (or higher depending on the cage design).



Note the information on the operating temperatures of greases, see page 68.



# Design and examples of bearing arrangements

## Design and applications

In practical application, a large number of different spindle bearing arrangements are used. The selection and arrangement are determined by their specific use in turning, milling and grinding or in high frequency motor spindles. 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  $n \cdot d_M = 2 \cdot 10^6 \text{ min}^{-1} \cdot \text{mm}$  and with pneumatic oil lubrication up to  $n \cdot d_M = 3,1 \cdot 10^6 \text{ min}^{-1} \cdot \text{mm}$ ) at the lowest possible operating temperatures. This requires the use of super precision bearings and correspondingly accurate adjacent parts.

The following guidelines are intended 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.

## Preload

Rigidly adjusted bearing arrangements, especially those with a short spacing between the bearings, react with a high degree of sensitivity to temperatures between the shaft and housing, since the preload within the bearing set may increase sharply and 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  $15^\circ$ . 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  $20^\circ$  or  $25^\circ$  are less sensitive.

# Design and examples of bearing arrangements

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

For rigidly preloaded bearing arrangements, speed reduction factors must be applied, see page 60.

In bearing arrangements adjusted by springs or hydraulic means, the stated speeds are achieved due to the lower thermal sensitivity, see dimension tables. In bearings with a contact angle of  $15^\circ$ , the  $\Delta T$  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  $M$ , see table, page 60.

## 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.

### 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.

### 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  $15^\circ$  contact angle have only 45% of the axial rigidity of bearings with a  $25^\circ$  contact angle but their radial rigidity is higher by only 10%. Calculation of the radial and axial rigidity, see page 62.

If the spindle bearing arrangement and boom is considered as a complete system, the total rigidity of a bearing arrangement with  $25^\circ$  bearings is normally better in a radial direction due to the wider support spacing than in one with  $15^\circ$  bearings. A bearing arrangement with  $20^\circ$  bearings offers a good intermediate value in this case.

### 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 generally 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.





## Bearing contact angle

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

### Contact angles, advantages and applications

| Advantages and applications | Contact angle  |  |  |
|-----------------------------|--|--|--|
|                             | 15°  | 20°  | 25°  |
| Advantages                  | <ul style="list-style-type: none"> <li>■ Radial rigidity</li> <li>■ Radial load carrying capacity</li> <li>■ Somewhat higher speed at small <math>\Delta T</math></li> </ul> | <ul style="list-style-type: none"> <li>■ Good axial and radial rigidity</li> <li>■ Combined loads</li> <li>■ Very high speeds at high <math>\Delta T</math></li> </ul> | <ul style="list-style-type: none"> <li>■ Axial rigidity</li> <li>■ Radial system rigidity</li> <li>■ Axial load carrying capacity</li> <li>■ Combined axial and radial load carrying capacity</li> <li>■ High permissible <math>\Delta T</math> between inner ring and outer ring</li> </ul> |
| Applications                | <ul style="list-style-type: none"> <li>■ Grinding machines</li> <li>■ Precision machining equipment</li> <li>■ Bearing arrangement on belt side</li> </ul>                   | <ul style="list-style-type: none"> <li>■ Milling at high output</li> <li>■ Machining centres</li> <li>■ Motor spindles</li> </ul>                                      | <ul style="list-style-type: none"> <li>■ Lathes</li> <li>■ Milling machines</li> <li>■ Drilling machines</li> <li>■ Machining centres</li> <li>■ Motor spindles</li> </ul>   |

### Bearing selection according to ball size and material

Spindle bearings with a B or RS in the designation are filled with large balls while the other types 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. The latter should be selected in preference for high speeds.

### Ceramic

Bearings with ceramic rolling elements have additional speed advantages.

### Bearing rings made from Cronidur

Bearings with rings made from Cronidur 30 and ceramic rolling elements are available in the design XC with small balls.

### Specifications for bearing selection

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

### Comparison of bearing designs

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

# Design and examples of bearing arrangements

## 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.

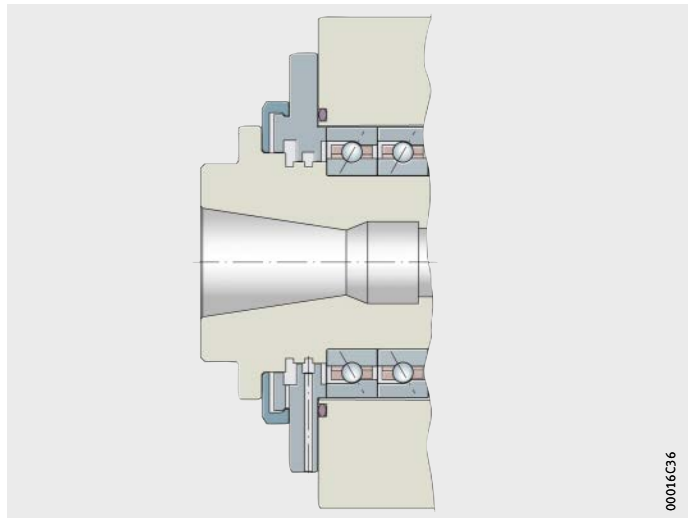
This thermally optimum bearing spacing  $L$  corresponds for spindle bearings with a  $25^\circ$  contact angle to approx. three times and with a  $20^\circ$  contact angle to four times the shaft diameter  $d$ ; in bearings with a  $15^\circ$  contact angle,  $L$  is approx.  $5 \cdot d$ , where the axial thermal expansion often takes effect too slowly due to the long bearing spacing. Such an approach is not very advisable in practice.

## Sealing

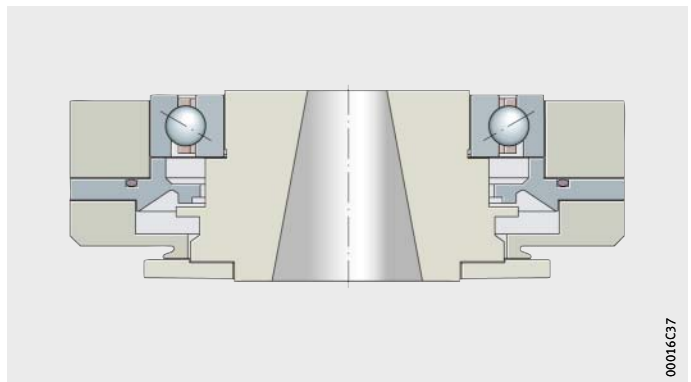
Main spindle bearing arrangements must be effectively sealed, especially at the spindle nose. If a non-contact labyrinth seal with a protective collar, narrow radial gaps (to  $h8/C9$ ), wide axial gaps (gap width  $\geq 3$  mm) and outlet holes is required due to the high speeds, complete sealing integrity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

When using grease lubrication, sealed bearings assist the effect of the labyrinth and prevent air flows through the bearing arrangement. Solutions with labyrinth seals for horizontal and vertical spindles are shown in *Figure 1* and *Figure 2*.

*Figure 1*  
Labyrinth seal  
for horizontal spindle



*Figure 2*  
Labyrinth seal  
for vertical spindle





## 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, see table, page 88.
3. Determine the lubrication, see page 68.
4. Select the bearing type and bearing size on the basis of speed suitability, design envelope and lubrication.
5. Check the grease operating life, *Figure 3*, page 75.
6. Calculate the load distribution on the bearings.
7. Check the fatigue strength of the bearing arrangement, see page 64.

## 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 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 also offers calculations by agreement as a service. It is advisable in this case to submit the complete bearing arrangement data using the template for bearing arrangement calculations in the appendix of the catalogue. This form is also available for download at [www.fag.de](http://www.fag.de)

## 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:<br>Point contact    with 100Cr6:        2 000 MPa<br>with Cronidur 30:    2 500 MPa<br>Line contact     with 100Cr6:        1 500 MPa<br>with Cronidur 30:    1 900 MPa |

# Design and examples of bearing arrangements

## Design of main spindles using BEARINX

### 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 thirty 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.

### BEARINX – a leading calculation program

In BEARINX, Schaeffler Technologies 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:

- the non-linear elastic deflection behaviour of the bearings
- the elasticity of shafts and axes
- the influence of fit, temperature and speed on the operating clearance or preload of the bearings and on their contact angle
- the profiling of rollers and raceways and raceway oscillations
- 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 offers the option of determining the actual load on spindle bearings.

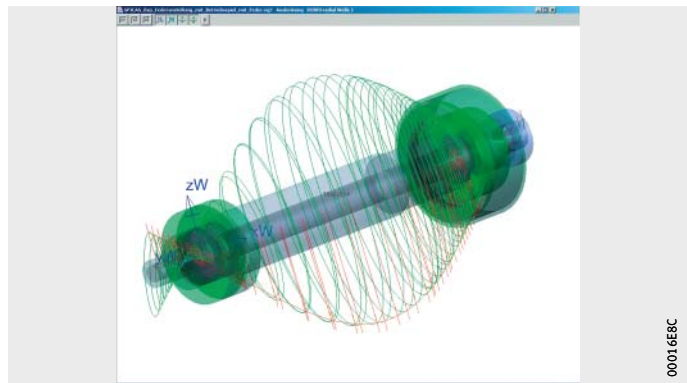


### Spindle calculation using BEARINX

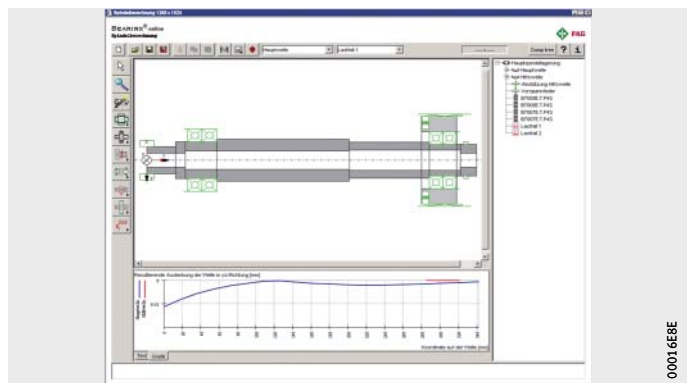
Spindle calculation by means of BEARINX, *Figure 3* and *Figure 4*, offers:

- 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 ISO 281 Appendix 4
- many other pieces of additional information.

*Figure 3*  
Deflection of the shaft



*Figure 4*  
Calculation of the load distribution



# Design and examples of bearing arrangements

## Comparison of bearing arrangements

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

- shaft diameter  $d = 70 \text{ mm}$
- bearing spacing  $L = 3 \cdot d$
- boom  $A = L/2$ .

## Comparison of applications and performance data

| Bearing arrangement |      | Typical application          | Speed suitability<br>% | 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



## Comparison between different spindle bearing arrangements

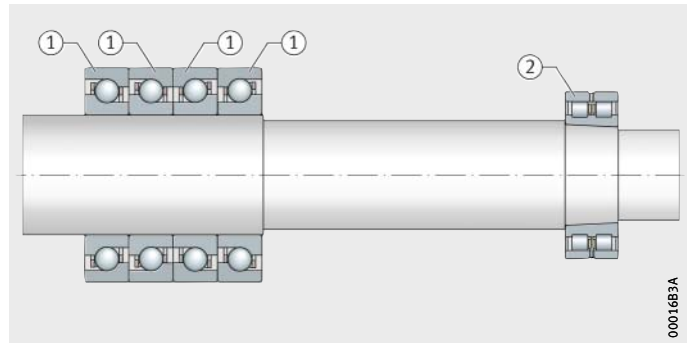
A comparison is presented of three different spindle bearing arrangements in relation to radial and axial rigidity, see page 90, and speed suitability, see page 91.

### Design of bearing arrangements

Bearing combination and arrangement:

- four spindle bearings in a tandem-O-tandem arrangement and a double row cylindrical roller bearing, *Figure 5*
- one double direction axial angular contact ball bearing and two double row cylindrical roller bearings, *Figure 6*
- two axial bearings and two double row cylindrical roller bearings, *Figure 7*.

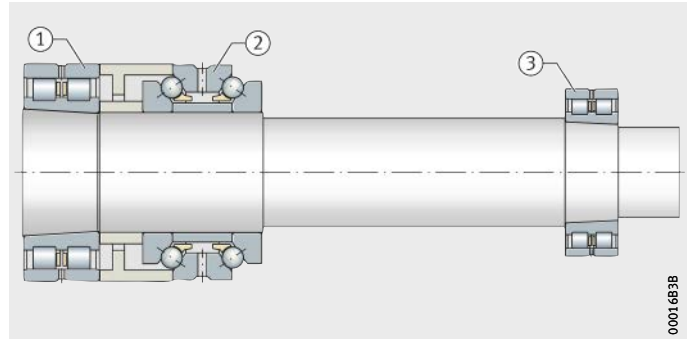
- ① Spindle bearing B7014-E-T-P4S-UL
- ② Cylindrical roller bearing NN3011-AS-K-M-SP



*Figure 5*

Bearing arrangement with spindle bearings B70

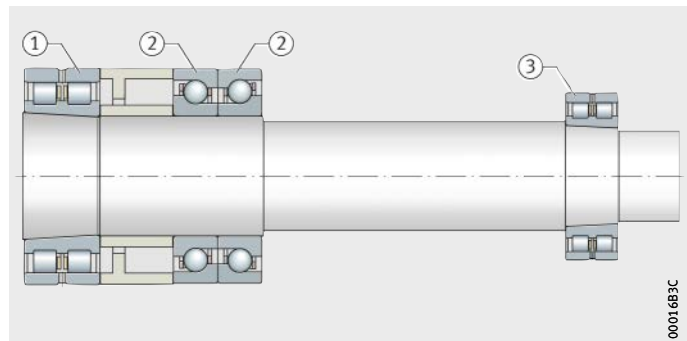
- ① Cylindrical roller bearing NN3014-AS-K-M-SP
- ② Double direction axial angular contact ball bearing 234414-M-SP
- ③ Cylindrical roller bearing NN3011-AS-K-M-SP



*Figure 6*

Bearing arrangement with axial angular contact ball bearing 2344

- ① Cylindrical roller bearing NN3014-AS-K-M-SP
- ② Axial bearing BAX70-F-T-P4S-DBL
- ③ Cylindrical roller bearing NN3011-AS-K-M-SP

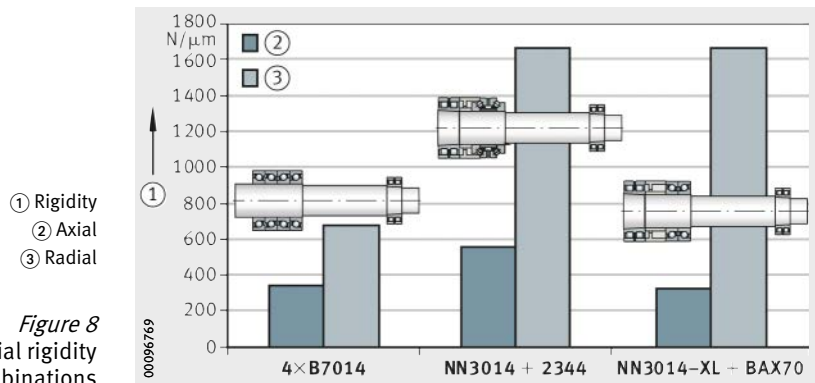


*Figure 7*

Bearing arrangement with axial bearings BAX

# Design and examples of bearing arrangements

- Axial and radial rigidity** The bearing arrangement in machine tools is subjected to frequently changing requirements. In order to achieve the highest possible machining accuracy, the aim must be to achieve high basic rigidity values.
- Increased radial rigidity** When cylindrical roller bearings NN30 are used, this gives the arrangement with an axial angular contact ball bearing 2344 and the arrangement with axial bearings BAX a rigidity that is approx. 2,5 times higher than in the case of four spindle bearings B70 of the same size, *Figure 8*.
- Consistent axial rigidity** The axial rigidity with axial bearings BAX is at the level of the bearing arrangement variants with the spindle bearings. The advantage when using the double direction axial angular contact ball bearings is 60%, *Figure 8*.



*Figure 8*  
Axial and radial rigidity of bearing combinations





### Speed suitability

In order that machine tools can achieve high cutting output, the bearing arrangement of the main spindle must be suitable for high speeds.

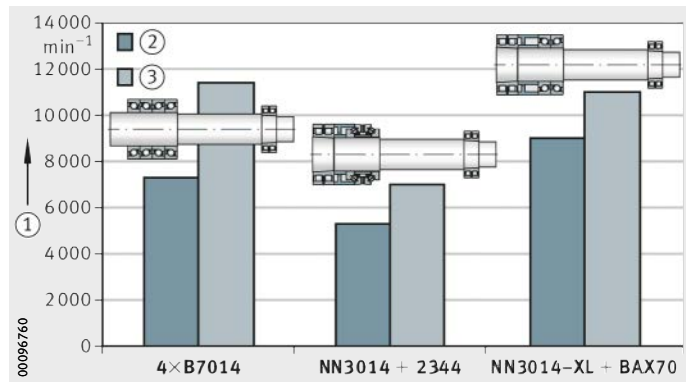
### Increased maximum speed

The bearing design with axial bearings (NN30 + BAX70) gives, in comparison with the bearing design with the axial angular contact ball bearing (NN30 + 2344), significantly higher maximum speeds. This is valid in the case of grease lubrication as well as in the case of minimal quantity oil lubrication.

In comparison with the design with spindle bearings (4×B70), the maximum speed of the bearing design with axial bearings (NN30 + BAX70) with grease lubrication is at a higher level. If minimal quantity oil lubrication is used, the achievable speed capacity is comparatively lower. This is due to the lower speed suitability of the cylindrical roller bearings NN30, *Figure 9*.

- ① Speed
- ② Grease
- ③ Minimal oil quantity

*Figure 9*  
Maximum speeds  
of bearing combinations

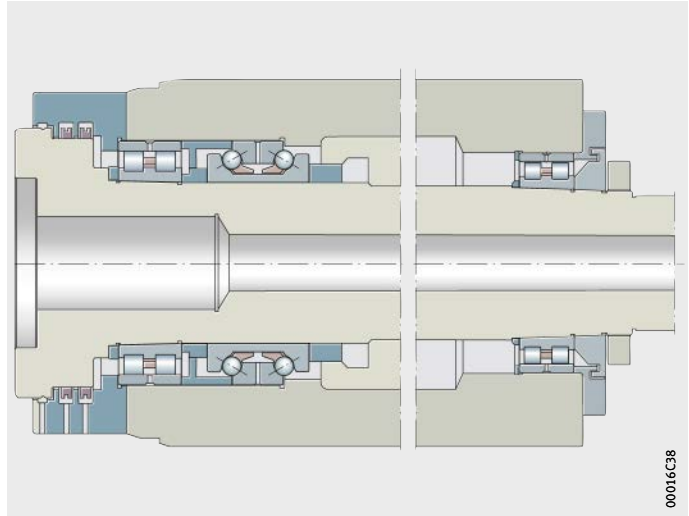


# Design and examples of bearing arrangements

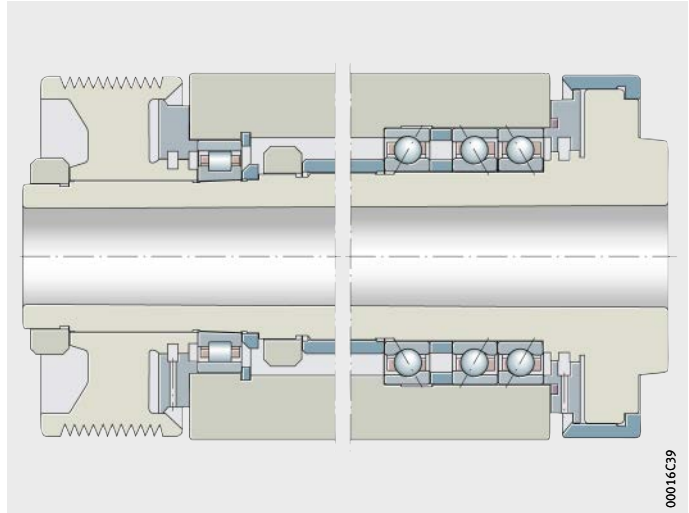
## Examples of bearing arrangements

Machining centre

*Figure 10*  
Milling spindle for high loads

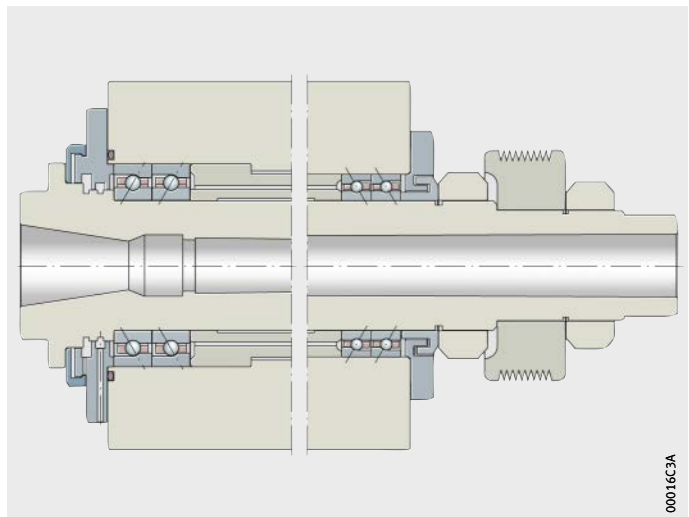


*Figure 11*  
Turning spindle



Machining centre

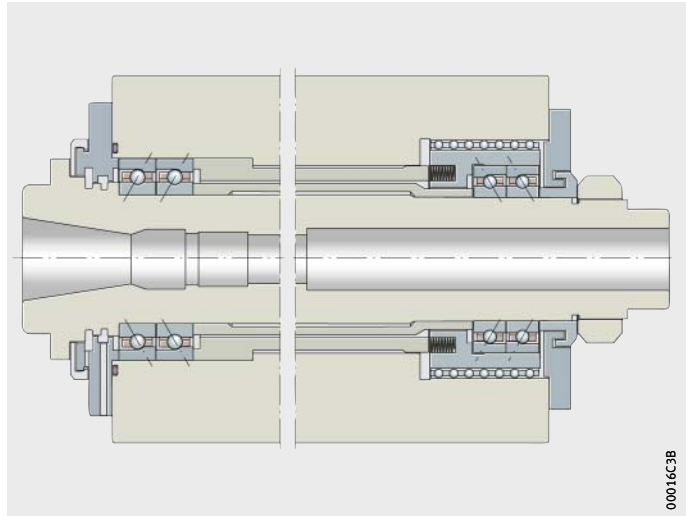
*Figure 12*  
Milling spindle for high speeds



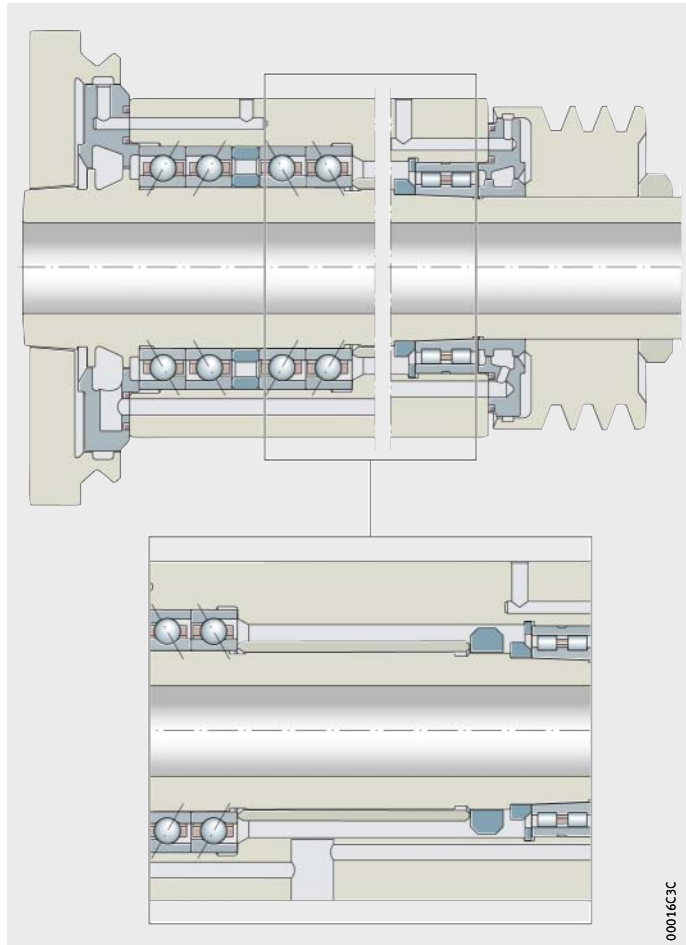


Machining centre

*Figure 13*  
Milling spindle  
for very high speeds

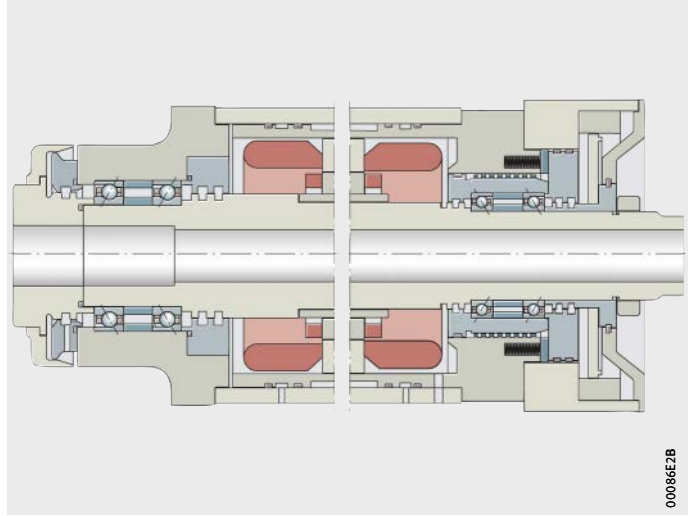


*Figure 14*  
Grinding spindle

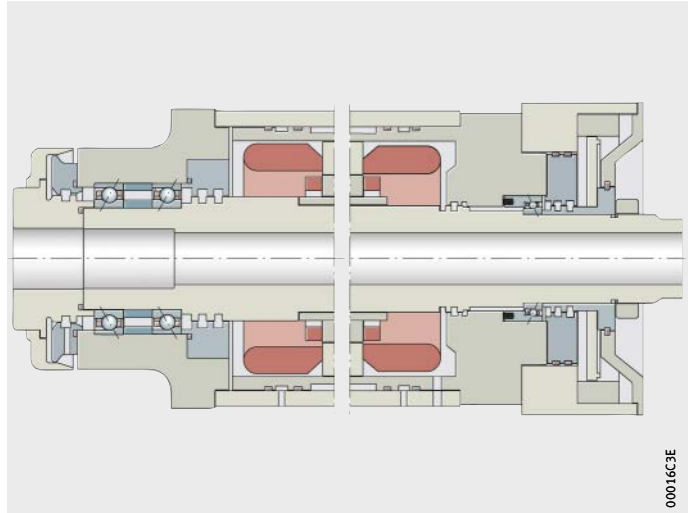


# Design and examples of bearing arrangements

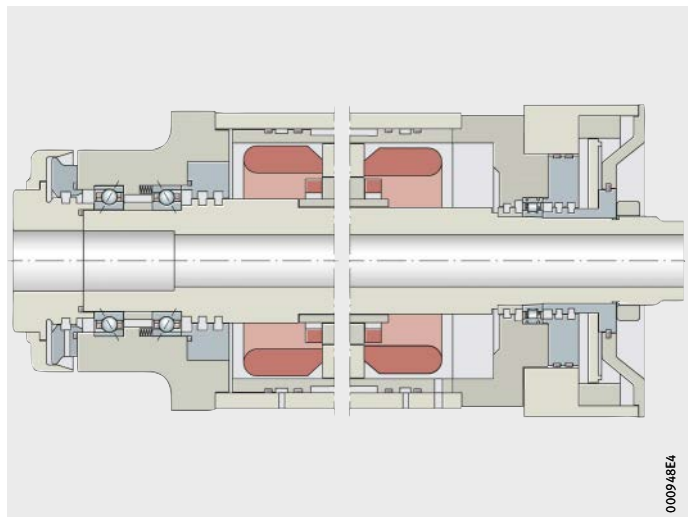
*Figure 15*  
High frequency motor spindle



Spring-preloaded non-locating bearing unit SPP  
*Figure 16*  
High frequency motor spindle



Cylindrical roller bearing N10...K-TR-PVPA1-SP  
*Figure 17*  
High frequency motor spindle





# Mounting

- 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.
- Provision of parts** Only approved parts should be used for mounting. Depending on the part, approval comprises dimensional inspection, optical inspection or even prebalancing.
- 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 or housing diameter. Spindle bearings are subdivided by bore and outside diameter tolerance into groups whose mean deviation is indicated on the packaging and the bearing. The width of a spindle bearing is also marked on the bearing as a deviation from the nominal dimension. These indications are, depending on the size of the bearing, subject to tolerances.

## Mounting Guidelines for mounting

The following guidelines must always be taken into account:

- Keep the mounting area 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 mounting paste.
- 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.

# Mounting

## 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 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 at [www.fag.de](http://www.fag.de).

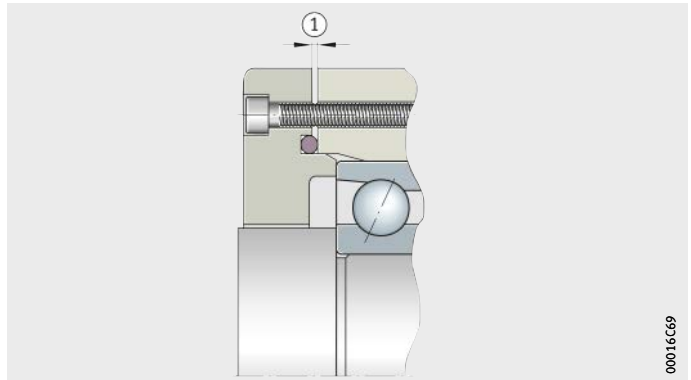
## Matching operations

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 covers used to clamp the bearings. Before clamping, a gap should be present, *Figure 1*.

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.

- Bearing bore  $d \leq 100$  mm:  
0,01 to 0,02 mm
- Bearing bore  $d > 100$  mm:  
0,015 to 0,03 mm
- ① Gap before tightening  
of the end cover fixing screws

*Figure 1*  
Matching end cover  
(recommendation)



## Greasing

The preservative applied to FAG super precision bearings is such that it is not necessary to wash out the bearings before greasing. Suitable rolling bearing greases and grease quantities see page 71 to page 74. The setting 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.

## Test run and grease distribution

In bearings with grease lubrication, a grease distribution cycle must be carried out on the bearings before the test run on the spindle. Information on the grease distribution cycle, see *Figure 4*, page 77. The information on the grease distribution cycle is available for download at [www.fag.de](http://www.fag.de) and can also be ordered from Schaeffler as a laminated overview card.



### Axial clamping of inner rings

Values for axial clamping of inner rings on the shaft using a precision nut, see tables and table Recommended clamping forces for axial angular contact ball bearings, page 99.

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.

### Spindle bearings

For spindle bearings B, HS, HC and XC of diameter series 719, 70 and 72, the applicable values are in accordance with the tables.

The stated values correspond to an end face pressure of approx. 10 MPa.

### Recommended clamping forces and nut tightening torques for spindle bearings

| Bore/<br>bore code | Clamping force<br>kN |        |      | Tightening torque<br>Nm |        |      | Thread   |
|--------------------|----------------------|--------|------|-------------------------|--------|------|----------|
|                    | 719                  | 70/BAX | 72   | 719                     | 70/BAX | 72   |          |
| 6                  | –                    | 1,49   | –    | –                       | 1,52   | –    | M6×0,5   |
| 7                  | –                    | 1,51   | –    | –                       | 1,70   | –    | M7×0,5   |
| 8                  | –                    | 1,53   | –    | –                       | 1,89   | –    | M8×0,75  |
| 9                  | –                    | 1,55   | –    | –                       | 2,09   | –    | M9×0,75  |
| 00                 | 0,66                 | 1,58   | 1,36 | 0,96                    | 2,30   | 1,99 | M10×0,75 |
| 01                 | 0,71                 | 1,64   | 1,45 | 1,19                    | 2,75   | 2,43 | M12×1    |
| 02                 | 0,79                 | 1,75   | 1,60 | 1,60                    | 3,52   | 3,23 | M15×1    |
| 03                 | 0,86                 | 1,84   | 1,73 | 1,93                    | 4,11   | 3,87 | M17×1    |
| 04                 | 0,99                 | 1,99   | 1,96 | 2,54                    | 5,13   | 5,04 | M20×1    |
| 05                 | 1,24                 | 2,32   | 2,45 | 3,87                    | 7,25   | 7,65 | M25×1,5  |
| 06                 | 1,55                 | 2,73   | 3,07 | 5,96                    | 10,0   | 11,3 | M30×1,5  |
| 07                 | 1,91                 | 3,22   | 3,83 | 8,10                    | 13,6   | 16,2 | M35×1,5  |
| 08                 | 2,34                 | 3,79   | 4,74 | 11,2                    | 18,2   | 22,7 | M40×1,5  |
| 09                 | 2,82                 | 4,45   | 5,79 | 15,1                    | 23,8   | 31,0 | M45×1,5  |
| 10                 | 3,36                 | 5,19   | 7,00 | 19,8                    | 30,6   | 41,3 | M50×1,5  |
| 11                 | 3,96                 | 6,02   | 8,36 | 25,6                    | 38,9   | 54,0 | M55×2    |
| 12                 | 4,62                 | 6,94   | 9,88 | 32,4                    | 48,6   | 69,3 | M60×2    |
| 13                 | 5,34                 | 7,94   | 11,6 | 40,4                    | 60,1   | 87,5 | M65×2    |
| 14                 | 6,12                 | 9,04   | 13,4 | 49,7                    | 73,4   | 109  | M70×2    |
| 15                 | 6,95                 | 10,2   | 15,4 | 60,3                    | 88,7   | 134  | M75×2    |
| 16                 | 7,85                 | 11,5   | 17,6 | 72,4                    | 106    | 163  | M80×2    |
| 17                 | 8,81                 | 12,9   | 20,0 | 86,2                    | 126    | 195  | M85×2    |
| 18                 | 9,82                 | 14,3   | 22,5 | 102                     | 148    | 233  | M90×2    |

# Mounting

**Recommended clamping forces and  
nut tightening torques  
for spindle bearings**  
continued

| Bore/<br>bore code | Clamping force<br>kN |        |       | Tightening torque<br>Nm |        |      | Thread  |
|--------------------|----------------------|--------|-------|-------------------------|--------|------|---------|
|                    | 719                  | 70/BAX | 72    | 719                     | 70/BAX | 72   |         |
| 19                 | 10,9                 | 15,9   | 25,2  | 119                     | 173    | 275  | M95×2   |
| 20                 | 12,0                 | 17,5   | 28,1  | 138                     | 201    | 322  | M100×2  |
| 21                 | 13,2                 | 19,3   | 31,2  | 159                     | 231    | 374  | M105×2  |
| 22                 | 14,5                 | 21,1   | 34,4  | 182                     | 265    | 433  | M110×2  |
| 24                 | 17,2                 | 25,0   | 41,5  | 235                     | 342    | 567  | M120×2  |
| 26                 | 20,1                 | 29,4   | 49,3  | 297                     | 434    | 729  | M130×2  |
| 28                 | 23,3                 | 34,1   | 57,9  | 370                     | 541    | 920  | M140×2  |
| 30                 | 26,7                 | 39,1   | 67,3  | 454                     | 666    | 1144 | M150×2  |
| 32                 | 30,4                 | 44,6   | 77,4  | 550                     | 808    | 1402 | M160×3  |
| 34                 | 34,3                 | 50,5   | 88,4  | 659                     | 971    | 1699 | M170×3  |
| 36                 | 38,4                 | 56,8   | 100,2 | 781                     | 1154   | 2036 | M180×3  |
| 38                 | 42,8                 | 63,4   | 112,7 | 918                     | 1360   | 2417 | M190×3  |
| 40                 | 47,4                 | 70,5   | 126,2 | 1070                    | 1589   | 2845 | M200×3  |
| 44                 | 57,5                 | 85,8   | 155,5 | 1423                    | 2125   | 3853 | Tr220×4 |
| 48                 | 68,4                 | 103    | –     | 1847                    | 2773   | –    | Tr240×4 |
| 52                 | 80,4                 | –      | –     | 2349                    | –      | –    | Tr260×4 |
| 56                 | 93,4                 | –      | –     | 2935                    | –      | –    | Tr280×4 |
| 60                 | 107                  | –      | –     | 3612                    | –      | –    | Tr300×4 |





**Axial angular contact ball bearings**

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

**Recommended clamping forces for axial angular contact ball bearings**

| Bore mm | Bore code | Clamping force kN |       | Tightening torque Nm |       | Thread  |
|---------|-----------|-------------------|-------|----------------------|-------|---------|
|         |           | over              | incl. | over                 | incl. |         |
| 25      | 05        | 1,2               | 2,5   | 3,8                  | 7,8   | M25×1,5 |
| 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 |
| 300     | 60        | 29,5              | 31,1  | 993                  | 1047  | Tr300×4 |
| 320     | 64        | 32,2              | 33,9  | 1155                 | 1216  | Tr320×5 |
| 340     | 68        | 35,0              | 36,8  | 1333                 | 1402  | Tr340×5 |
| 360     | 72        | 37,9              | 39,7  | 1528                 | 1600  | Tr360×5 |
| 380     | 76        | 40,9              | 42,7  | 1739                 | 1816  | Tr380×5 |
| 400     | 80        | 32,9              | 45,8  | 1472                 | 2050  | Tr400×5 |

# Mounting

## 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 axial runout during the clamping operation, the clamping inserts should be ground together with the thread and the axial face.

## Clearance adjustment of cylindrical roller bearings

Cylindrical roller bearings with a tapered bore are fitted with clearance, clearance-free or with preload, see table, page 61. This can be carried out with the aid of an FAG enveloping circle gauge to an accuracy of  $\pm 1 \mu\text{m}$ .

## 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 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, *Figure 2*.



*Figure 2*  
Measuring the raceway diameter of the outer ring



- Transfer this dimension to the two hardened and precision ground measuring surfaces of the enveloping circle gauge, *Figure 3*.



*Figure 3*  
Transferring the raceway diameter  
to the enveloping circle gauge

- Then position the gauge on the inner ring and roller and cage assembly premounted on the tapered shaft, *Figure 4*.



*Figure 4*  
Positioning the enveloping circle  
gauge

## Mounting

- 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°, *Figure 5*. 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.



*Figure 5*  
Measuring the spacing  
from the shaft shoulder



### 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 (factor F, see table) larger than the radial expansion induced in this way. Surface bur- nishing and the elastic expansion of the inner ring and the contrac- tion of the shaft are contributory factors here.

Drive-up distance A:

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

A mm

Drive-up distance

F –

Factor, see table

$\Delta G$   $\mu\text{m}$

Change in radial clearance.

### Hollow shaft ratio and drive-up factor

| Hollow shaft ratio<br>$d_B/d'^{1)}$ | Drive-up factor<br>F |
|-------------------------------------|----------------------|
| 0 to 0,2                            | 13                   |
| 0,2 to 0,3                          | 14                   |
| 0,3 to 0,4                          | 15                   |
| 0,4 to 0,5                          | 16                   |
| 0,5 to 0,6                          | 17                   |
| 0,6 to 0,8                          | 18                   |
| 0,8 to 0,9                          | 19                   |

<sup>1)</sup>  $d_B$  = bore of hollow shaft

$d'$  = tapered seat diameter, measured at the centre of the taper.

# Mounting

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

- Procedure
- 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  $\mu\text{m}$ , 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, while the dial gauge should be positioned as close as possible to the bearing.

Scraping marks can be avoided in the mounting of cylindrical roller bearings if the inner ring is not tilted relative to the outer ring and the spindle is rotated back forth while it is being slid into place.

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

- Determine the spacing between the inner ring and the locating shoulder, for example by means of gauge blocks at four 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  $A = \text{factor } F \cdot \text{change in radial clearance } \Delta G$

Given data Hollow shaft ratio  $d_B/d'$  = 0,55  
Drive-up factor  $F$ , see table, page 103 = 17  
Change in radial clearance  $\Delta G$  = 20  $\mu\text{m}$

Calculation Drive-up distance  $A = 17 \cdot 20 \mu\text{m} = 340 \mu\text{m} = 0,34 \text{ mm}$

## PrecisionDesk

The free-of-charge Schaeffler app PrecisionDesk for super precision bearings includes services for rotary and linear bearings of a high precision design, *Figure 6*. It assists fitters and engineers in the selection and mounting of bearing arrangement components in machine tools, textile and printing machinery, in food and packaging equipment and all other applications that require high precision bearing arrangements.



*Figure 6*  
PrecisionDesk  
for super precision bearings



The advantage for the user is that the data can be accessed from any smartphone, tablet, PC or at a local mounting station. In future, it will for example be possible to call off bearing-specific spindle and rotary table bearings directly and store or send these with the aid of the app for the purposes of documentation. For spindle bearings, it is possible to create electronic bearing-specific data sets in the .csv format and use these, for example, for a logistics system. The app offers Schaeffler customers the possibility of monitoring their own inventory and improving quality in mounting. With such a service tool, Schaeffler is a pioneer in the market.

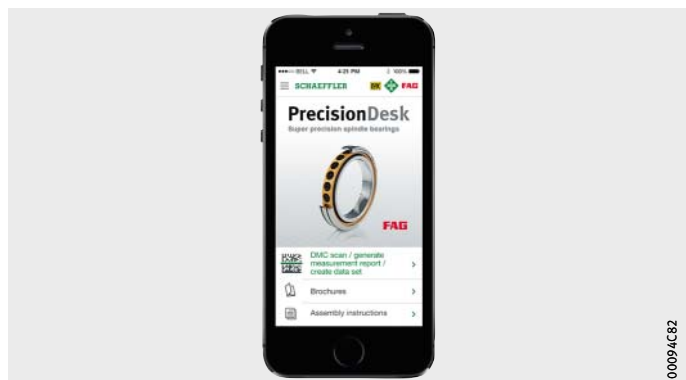
Reading off the data matrix code (DMC) on the bearing or the bearing packaging gives access to the scope of performance of the program.

Scope of performance

The scope of performance of the app comprises, *Figure 7*:

- checking of data matrix codes (anti-piracy protection)
- measurement records for spindle bearings
- recommendations for mounting
- performance data
- service.

*Figure 7*  
Scope of performance  
of PrecisionDesk



# Mounting

- Anti-piracy protection
- Checking of data matrix code (DMC), *Figure 8.*



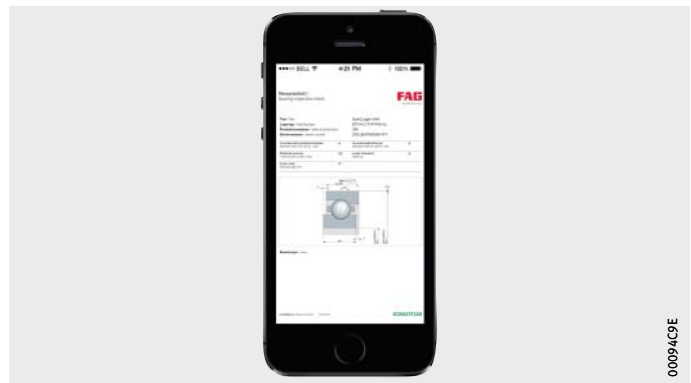
*Figure 8*  
Data matrix code on rolling bearing

## Measurement records for spindle bearings

The creatable measurement records contain the following:

- bearing
- designation
- date of manufacture
- actual value codes (bore diameter, outside diameter)
- width deviation
- contact angle
- projection.

*Figure 9*  
Measurement record for spindle bearing



## Recommendations for mounting

- Correct grease quantity
- Grease distribution cycle
- Universal bearing sets
- Permissible heating temperatures
- Designation and marking.

## Performance data

- Catalogue information
- Additional product information
- Direct access to Schaeffler Library.

The app can be used on Android, IOS and Windows-based operating systems and can be downloaded from the corresponding app stores.





## Mounting and dismounting

The Schaeffler Industrial Service experts offer mounting and dismounting services for rolling bearings that are applicable across industrial sectors. They have detailed knowledge and extensive experience in all industrial sectors.

The experts in the Industrial 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 and dismounting services include:

- mounting and dismounting of rolling 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.

### Advantages

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.

## Rental of tools

Customers who require special mounting and dismounting 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 Industrial Service function is commissioned to carry out the particular activity, rental costs are not generally incurred.

# Mounting

## Devices for the mounting of super precision bearings

### FAG enveloping circle gauge MGI 21

Gauges and heating devices for the mounting of spindle bearings can be obtained via Schaeffler.

The enveloping circle gauge is used to set the radial internal clearance of cylindrical roller bearings with a separable inner ring. It is suitable for cylindrical roller bearings NU4920-K to NNU4948-K and NNU4920 to NNU4948. Bearings with a bore diameter of 100 to 240 mm have separable inner rings.

In the FAG enveloping circle gauge MGI 21, the inner enveloping circle of the roller and cage assembly is measured by two hardened and precision ground surfaces, one of which is movable.

After mounting of the outer ring, the gauge is set to the internal enveloping circle of the roller and cage assembly. This dimension is measured using a snap gauge, for example the SNAP-GAUGE. It is then possible to set the inner ring to the diameter that gives the required radial internal clearance.

Bearings with a tapered bore are displaced on the tapered seat of the shaft in order to set the preload or bearing clearance. For bearings with a cylindrical bore, preground inner rings are used (suffix F12) and finish ground to the required raceway diameter.

Ordering example for NNU4920: **MGI21-NN4920**

FAG enveloping circle gauge MGI 21

*Figure 10*  
Gauge for cylindrical roller bearings with separable inner ring



00016CGE



**FAG enveloping circle gauge MGA 31**

The MGA 31 is used to set the radial clearance of cylindrical roller bearings with a tapered bore and separable outer ring. It is suitable for cylindrical roller bearings NN3006-K to NN3048-K and N1006-K to N1048-K. The gauge is used to precisely set the radial clearance or preload of cylindrical roller bearings.

The raceway diameter of the mounted outer ring is measured using a conventional internal gauge. This dimension is transferred to the two hardened and precision ground measuring surfaces of the enveloping circle gauge. The tapered shaft with the premounted inner ring and roller and cage assembly can then be inserted in the gauge. The shaft is moved axially by the hydraulic method until the precision indicator of the enveloping circle gauge shows the required radial internal clearance or preload.

Ordering example for NN3006-K: **MGA31-NN3006**

FAG enveloping circle gauge MGA 31

*Figure 11*  
Gauge for cylindrical roller bearings with separable outer ring



# Mounting

## FAG snap gauge SNAP-GAUGE

This gauge is used for checking the diameter of cylindrical shafts and workpieces of all types directly on the machine tool and for setting of the enveloping circle gauge MGI 21.

The actual dimension of the workpiece can be determined precisely. The snap gauge functions as a comparator gauge. Its setting is checked using master shims that can be obtained for each diameter.

Ordering example for shaft diameter 120 mm:

**SNAP-GAUGE-100/150** (snap gauge)

**SNAP-GAUGE.MASTER120** (master shim)

## Ordering designation SNAP-GAUGE

| Ordering designation | Diameter range mm |
|----------------------|-------------------|
| SNAP-GAUGE-30/60     | 30 – 60           |
| SNAP-GAUGE-60/100    | 60 – 100          |
| SNAP-GAUGE-100/150   | 100 – 150         |

FAG snap gauge SNAP-GAUGE

*Figure 12*  
Snap gauge



## FAG taper gauge MGK 132

For measuring outer tapers with a taper angle of 0° to 6° and taper diameters of 90 mm to 510 mm, the FAG taper gauge MGK 132 is recommended.

With this gauge, the reproducibility of measurement results is within 1 μm. The MGK 132 rests on the workpiece with four hardened, ground and lapped ledges. The ledges form an angle of 90°. A stop on the front or rear precisely defines the position of the gauge on the taper. Between the support ledges, the measurement slide runs on preloaded roller bearings. A dial gauge fixed in the housing acts against the measurement slide and indicates the deviation of the taper diameter from the nominal value. The gauge is set using a reference taper, which is available by agreement.

FAG taper gauge MGK 132

*Figure 13*  
Taper gauge





### FAG taper gauge MGK 133

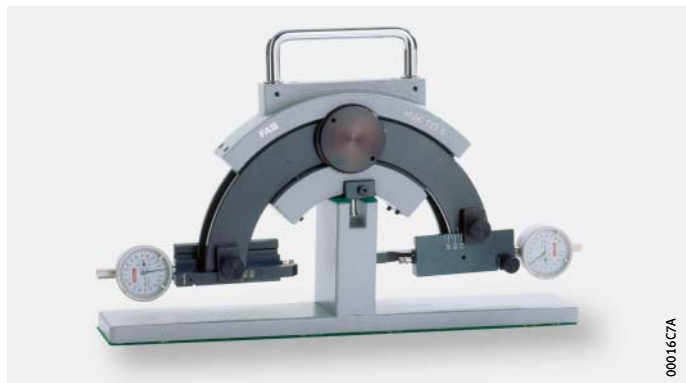
The taper gauge MGK 133 is suitable for outer tapers 1:12 and 1:30 and taper diameters of 27 mm to 205 mm.

It rests on the taper with four hardened and polished support pins. The position of the gauge on the taper is defined by these pins and one stop. The stop can be attached to either the front or back of the gauge. The gauge contains two movable measuring brackets, one of which is in contact with the smaller taper diameter while the other, at a fixed distance, is in contact with the larger taper diameter. The deviation of the taper diameter from the nominal value is displayed in both measurement planes by a precision indicator.

The reproducibility of the measurement results is less than 1  $\mu\text{m}$ . The gauge is set using a reference taper corresponding to the taper diameter, which is available by agreement.

FAG taper gauge MGK 133

*Figure 14*  
Taper gauge



In order to prepare a proposal for taper gauge and the corresponding setting taper, we require from the customer a mounting drawing of the taper to be produced.

# Mounting

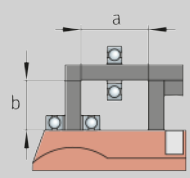


## Induction heating devices

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 here 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. The induction heating devices HEATER10 to HEATER150 are suitable for workpieces up to 150 kg and can be used in either a mobile or stationary capacity.

Detailed information, including information on larger designs, is given in brochure TPI 200.

Induction heating devices and their characteristics are shown in the following tables.

## Characteristics of heating devices

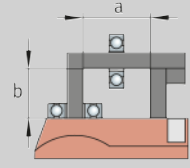


| Heating devices   | HEATER10   | HEATER20  |
|---|--|---|
|  |  |  |
| Power consumption max. <sup>1)</sup>  | 2,3 kVA  | 3,6 kVA   |
| Operating voltage   | 230 V  | 230 V   |
| Frequency <sup>2)</sup>   | 50 Hz  | 50 Hz   |
| Current rating  | 10 A   | 16 A  |
| Mass  | 7 kg   | 17 kg   |
| Length  | 240 mm   | 345 mm  |
| Width   | 200 mm   | 205 mm  |
| Height  | 255 mm   | 230 mm  |
| Dimension a   | 65 mm  | 120 mm  |
| Dimension b   | 100 mm   | 100 mm  |
| Ledges (incl.) for workpieces with bore min.                                      | 15 mm  | 20 mm   |
|   | 30 mm  | 35 mm   |
|   | 45 mm  | 60 mm   |
|   | Stepped stand  |   |
| Ledges (accessories) for workpieces with bore min.                                | 10 mm  | 10 mm   |
|   | 20 mm  | 15 mm   |
|   |  | 45 mm   |

<sup>1)</sup> If lower voltage is used, the power will be reduced.

<sup>2)</sup> Heating devices with other rated voltages and frequencies and higher power ratings are available on request.



**Characteristics of heating devices**  
continued

| Heating devices   | HEATER40  | HEATER150  |
|---|---|--|
| <br>00016C85 | <br>00019F74 | <br>00019F76 |
| Power consumption max. <sup>1)</sup>  | 3,6 kVA   | 12,8 kVA   |
| Voltage   | 230 V   | 400 V  |
| Frequency <sup>2)</sup>   | 50 Hz   | 50 Hz  |
| Current   | 16 A  | 25 A   |
| Mass  | 26 kg   | 57 kg  |
| Length  | 340 mm  | 500 mm   |
| Width   | 240 mm  | 290 mm   |
| Height  | 295 mm  | 480 mm   |
| Dimension a   | 180 mm  | 210 mm   |
| Dimension b   | 160 mm  | 210 mm   |
| Ledges (incl.) for workpieces with bore min.  | 20 mm   | 45 mm  |
|   | 45 mm   | 70 mm  |
|   | 70 mm   | 100 mm   |
| Ledges (accessories) for workpieces with bore min.  | 15 mm   | 20 mm  |
|   | –   | 30 mm  |
|   | 35 mm   | –  |
|   | –   | 60 mm  |
|   | 60 mm   | –  |
|   |   | 85 mm  |

1) If lower voltage is used, the power will be reduced.

2) Heating devices with other rated voltages and frequencies and higher power ratings are available on request.

# Mounting

**Training courses** For the maintenance of machine tool main spindles, Schaeffler regularly offers a one-day training course on mounting, especially for supervisors and fitters at machine tool operators and manufacturers. 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.

**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.

**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.

**Other products and services** Catalogue IS 1 contains a complete overview of the portfolio offered by the Industrial Services Division. The catalogue and further information on all the services described here can be obtained at [www.schaeffler.de/services](http://www.schaeffler.de/services).





# Bearing monitoring

## **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.

## **Types of monitoring**

### **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.

### **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.

### **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 here. 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.

# Bearing monitoring

## 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, which 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:

- measurement as close as possible to the bearing
- measurement as continuously as possible
- prevention of 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.

t = time  
 $\vartheta$  = temperature  
① Normal  
② End of grease operating life

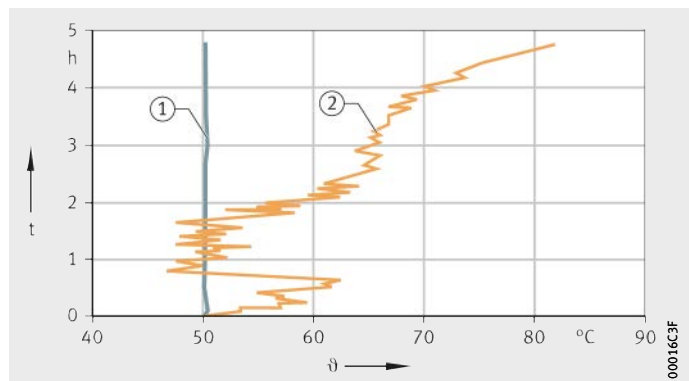
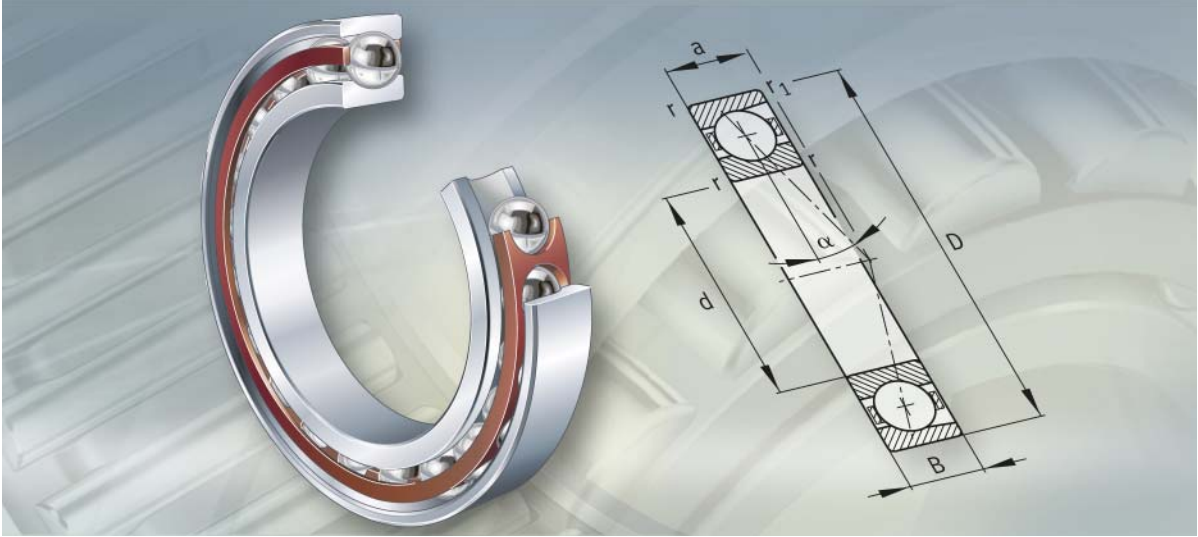


Figure 1  
Bearing temperature behaviour





# Spindle bearings

Single row

For main spindles in machine tools

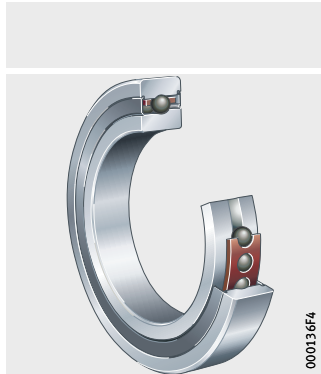
# Spindle bearings

|                         | Page  |
|-------------------------|---|
| <b>Product overview</b> | Spindle bearings ..... 120  |
| <b>Features</b>         | Extensive range of product variants..... 121  |
|                         | Universal bearings..... 122   |
|                         | Universal bearing sets ..... 123  |
|                         | Load carrying capacity and contact angle ..... 124  |
|                         | Bearing types and product characteristics ..... 125   |
|                         | Hybrid bearings ..... 126   |
|                         | Cronidur bearings ..... 127   |
|                         | Open and sealed spindle bearings ..... 128  |
|                         | Direct Lube bearings ..... 129  |
|                         | Cage ..... 129  |
|                         | Bearing designations ..... 130  |
|                         | Marking of bearings ..... 131   |
| <b>Dimension tables</b> | Spindle bearings<br>With large or small balls, steel or ceramic balls,<br>steel or Cronidur rings, open or sealed ..... 132 |



# Product overview Spindle bearings

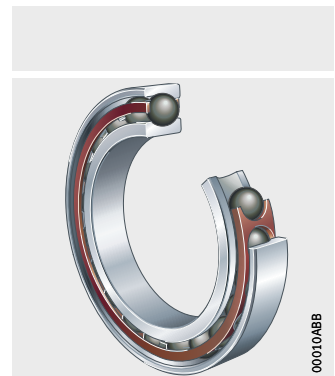
**Universal bearings**  
With small or large balls



**Steel or ceramic balls**



**Bearing rings**  
Standard rolling bearing steel or  
Cronidur 30



**Open or sealed**  
**Direct Lube bearings**  
For pneumatic oil lubrication



# Spindle bearings

**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, *Figure 1*. 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.

## 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 dimension 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.



*Figure 1*  
FAG spindle bearings



# Spindle bearings

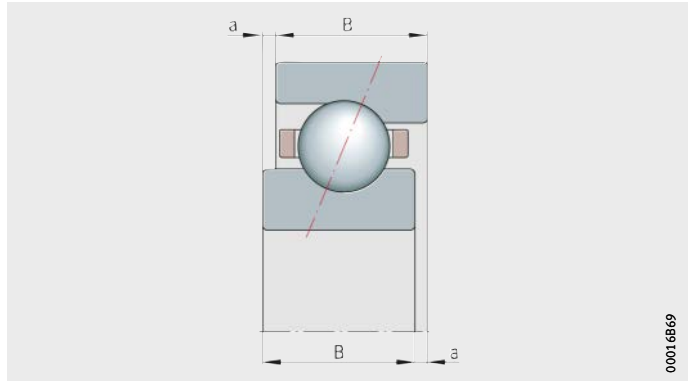
## Universal bearings

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, *Figure 2*.

B = bearing width  
a = projection

*Figure 2*  
Universal preload system



### Advantages

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. Universal bearing sets, see page 123.

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 the housing 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, *Figure 3*, page 123. This provides logistical advantages for the customer, especially in spare parts procurement and stockholding of bearings.





## 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.

### Marking of bearing sets

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

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

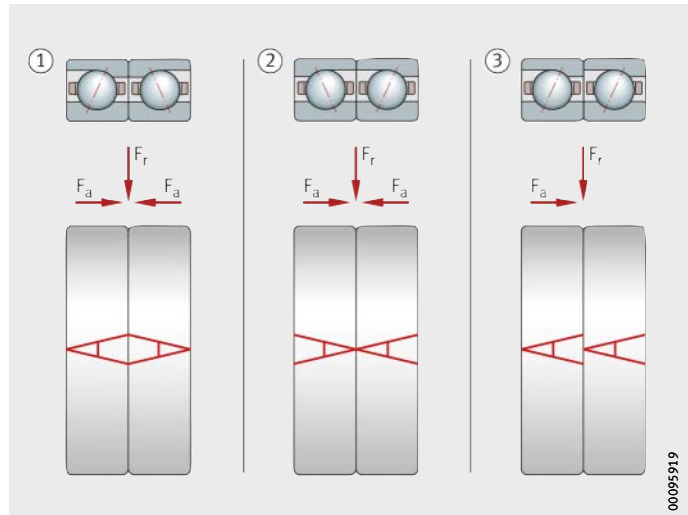
A “U” stands for “Universal”, for example in DU. After these letters, the preload class is then indicated, for example “L” for light preload, in this case DUL. Bearing designations, see also page 130.

Universal bearing sets can be mounted in any arrangement required. Possible bearing arrangements are shown in *Figure 3*.

$F_r$  = 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

*Figure 3*  
 Bearing arrangements  
 of a DU set



### Ready-to-fit bearing sets

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. However, the latter offer significant logistical advantages over the ready-to-fit sets, especially in spare parts procurement and stockholding.

# Spindle bearings

## 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 support axial loads in one direction only, *Figure 3*, page 123.

### Contact angle

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

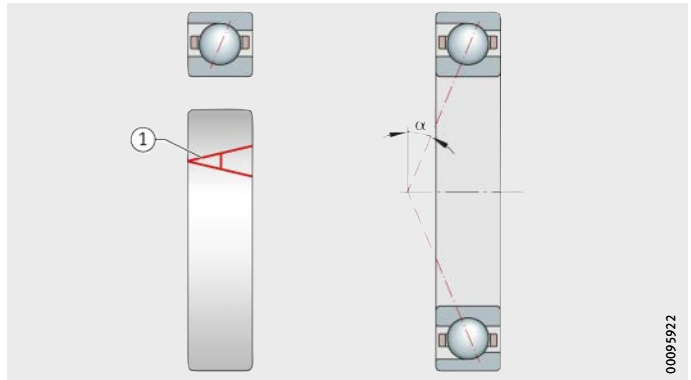
FAG spindle bearings are available with the contact angle:

- $\alpha = 15^\circ$  (suffix C)
- $\alpha = 20^\circ$  (suffix D)
- $\alpha = 25^\circ$  (suffix E).

The load direction of the outer ring is marked on the cylindrical surface of the outer ring, *Figure 4*. The open side of the symbol indicates the side of the outer ring capable of supporting axial load (the large shoulder).

$\alpha$  = contact angle  
① Marking

*Figure 4*  
Symbol indicating the load direction of the outer ring



## Bearing types and product characteristics

Universal spindle bearings are available in the following designs: B, RS and H bearings.

### B spindle bearings

- Classical spindle bearing
- With large balls
- Contact angle 15° and 25°
- High load carrying capacity and high rigidity
- For moderate speed level.

### RS spindle bearings

- With large balls
- Contact angle 20°
- Suitable for high to very high speeds due to bearing internal design with optimised friction
- Kinematic insensitivity to tilting
- High load carrying capacity especially under combined axial and radial load
- 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.

### Design of bearing types

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

H spindle bearings are also available with Cronidur rings.

Bearing selection according to ball size and bearing arrangement, see page 14.



# Spindle bearings

## 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  $\text{Si}_3\text{N}_4$ ), *Figure 5*.

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



*Figure 5*  
Hybrid spindle bearings

### Advantages

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, see page 17.

## **Cronidur bearings**

Cronidur bearings are suitable for very high speeds and have very high load carrying capacity. Cronidur bearings are always designed as hybrid bearings, with bearing rings made from Cronidur 30 and rolling elements made from ceramic ( $\text{Si}_3\text{N}_4$ ). Cronidur 30 is a highly nitrided, corrosion-resistant steel, see page 17.

### **Advantages**

Cronidur 30 has, in comparison with the normal rolling bearing steel 100Cr6, a significantly finer structure. As a result, less heat is generated in the bearing and the permissible contact pressure is higher.

In the mixed friction region Cronidur 30 has proved highly effective in comparison with the standard material 100Cr6.

It is also significantly superior to the conventional rolling bearing steels on the criteria of corrosion resistance and high temperature hardness.

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



# Spindle bearings

## Open and sealed spindle bearings

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

### Sealing

In sealed designs, the rolling element system is protected by gap seals on both sides of the bearings, *Figure 6*.

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

### Suffixes

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



① Gap seals

*Figure 6*  
Sealed spindle bearings

### Lubrication

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.

Further information on lubrication, see page 14.

## Direct Lube bearings

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, *Figure 7*. 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.



① Circumferential annular grooves

*Figure 7*  
Direct Lube bearing

### Cage

Spindle bearings have solid window cages made from laminated fabric (suffix T). The cage is guided on the outer ring, see page 197.

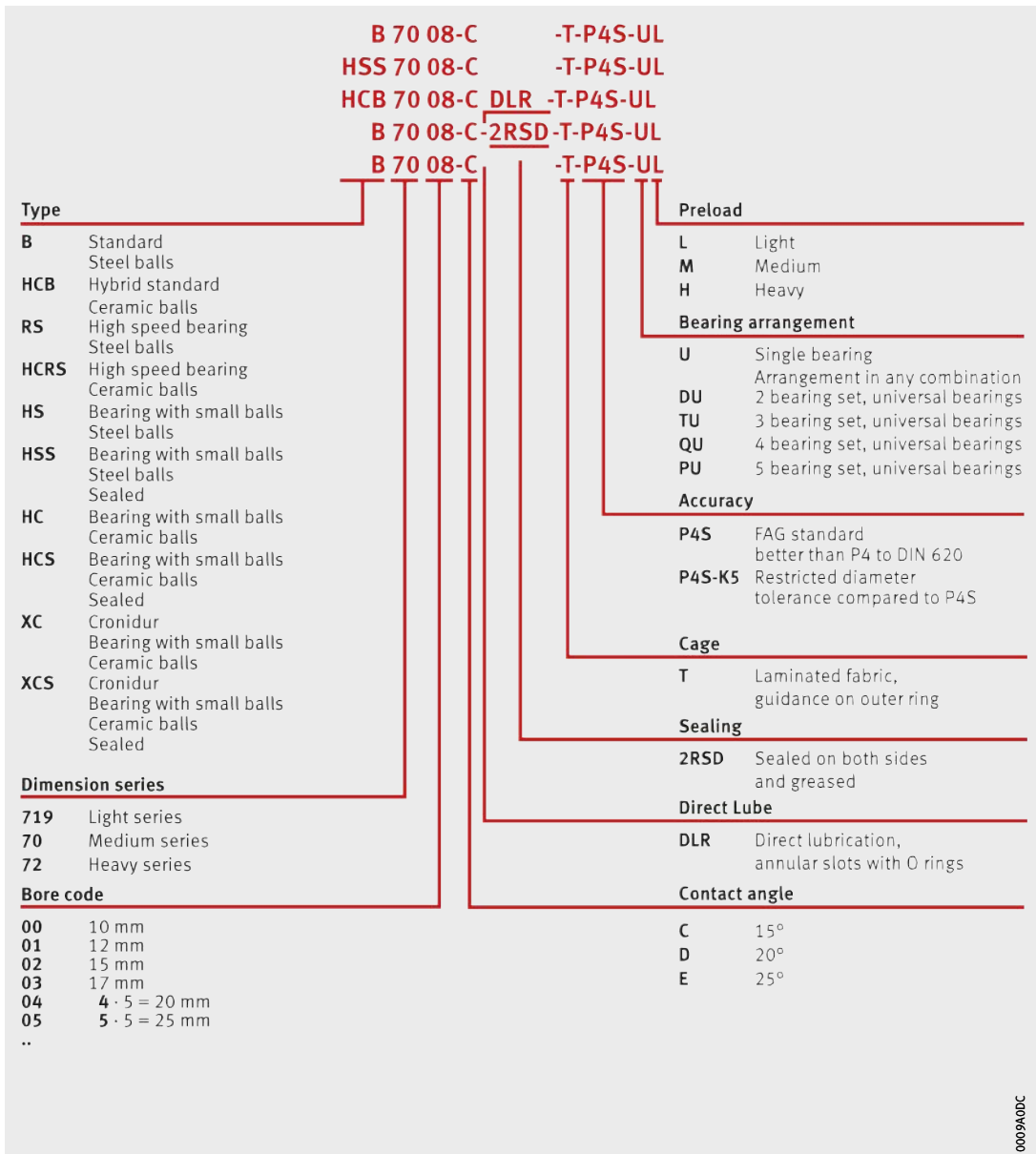


Check the chemical resistance of the seal and cage material when using synthetic greases and lubricants with EP additives.

Additives in the oil can impair the operating life of the cages at high temperatures.

# Spindle bearings

**Bearing designations** The structure for spindle bearings is shown in *Figure 8*.



*Figure 8*  
Bearing designations



## Marking of bearings

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

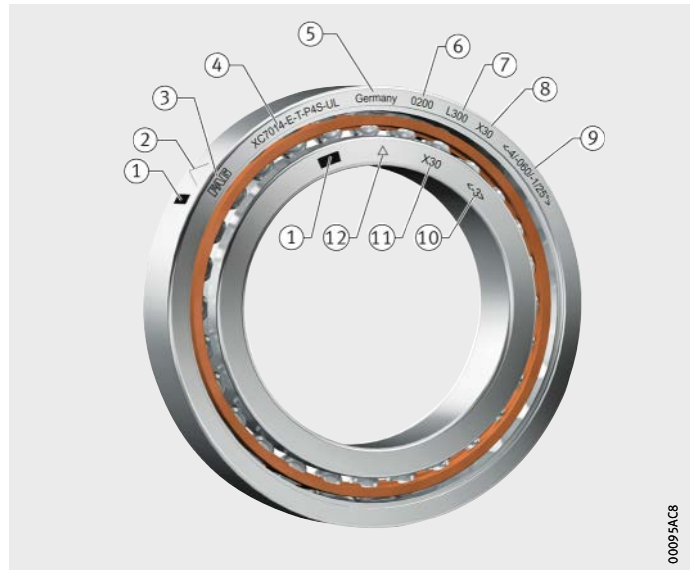
In addition to the actual bearing designation, this also contains information on the:

- tolerances and actual value codes (bore/outside diameter/width/projection<sup>1)</sup>/contact angle<sup>1)</sup>)
- mounting position indicated by the marking on the outside surface of the outer ring (symbol indicating the load direction of the outer ring), *Figure 4*, page 124.

These indications are, depending on the size of the bearing, subject to tolerances. Marking on the end faces of the bearing rings is shown in *Figure 9* and *Figure 10*.



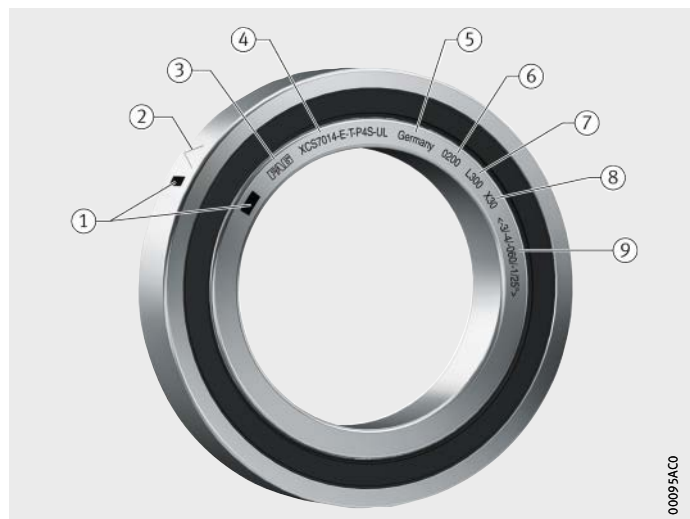
- ① Data matrix code
- ② Symbol indicating the load direction of the outer ring
- ③ Trademark
- ④ Short designation
- ⑤ Country of manufacture
- ⑥ Internal code
- ⑦ Internal code
- ⑧ Special material for outer ring
- ⑨ Actual value code for outside diameter/actual deviation of width in  $\mu\text{m}$ /actual deviation from nominal projection in  $\mu\text{m}$ /actual contact angle<sup>1)</sup>
- ⑩ Actual value code for bore
- ⑪ Special material for inner ring
- ⑫ Symbol for largest wall thickness of inner ring



*Figure 9*

Marking of open 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 Special material for the inner ring
- ⑨ Value code for bore/actual value code for outside diameter/actual deviation of width in  $\mu\text{m}$ /actual deviation from nominal projection in  $\mu\text{m}$ /actual contact angle<sup>1)</sup>



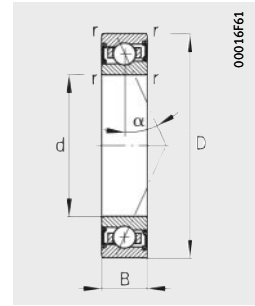
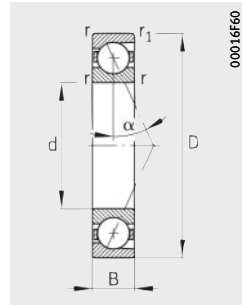
*Figure 10*

Marking of sealed spindle bearings

<sup>1)</sup> Deviation from nominal projection and actual contact angle: to be introduced progressively together with new spindle bearing packaging starting in 01/2016.

# Spindle bearings

With large or small balls  
 Steel or ceramic balls  
 Steel or Cronidur rings  
 Open or sealed



**Dimension table** - Dimensions in mm

| Designation <sup>1)2)</sup> |                        |                        | Mass<br>m<br>≈ kg | Dimensions |    |   |     |                | Contact angle<br>α<br>° | Mounting dimensions   |                       |
|-----------------------------|------------------------|------------------------|-------------------|------------|----|---|-----|----------------|-------------------------|-----------------------|-----------------------|
| Series 719                  | Series 70              | Series 72              |                   | d          | D  | B | r   | r <sub>1</sub> |                         | d <sub>a</sub><br>h12 | D <sub>a</sub><br>H12 |
| <b>B71900-C-T-P4S</b>       | –                      | –                      | 0,01              | <b>10</b>  | 22 | 6 | 0,3 | 0,3            | 15                      | 13                    | 19,5                  |
| <b>B71900-E-T-P4S</b>       | –                      | –                      | 0,01              | <b>10</b>  | 22 | 6 | 0,3 | 0,3            | 25                      | 13                    | 19,5                  |
| <b>HCB71900-C-T-P4S</b>     | –                      | –                      | 0,009             | <b>10</b>  | 22 | 6 | 0,3 | 0,3            | 15                      | 13                    | 19,5                  |
| <b>HCB71900-E-T-P4S</b>     | –                      | –                      | 0,009             | <b>10</b>  | 22 | 6 | 0,3 | 0,3            | 25                      | 13                    | 19,5                  |
| <b>HS71900-C-T-P4S</b>      | –                      | –                      | 0,011             | <b>10</b>  | 22 | 6 | 0,3 | –              | 15                      | 13                    | 19,5                  |
| <b>HS71900-E-T-P4S</b>      | –                      | –                      | 0,01              | <b>10</b>  | 22 | 6 | 0,3 | –              | 25                      | 13                    | 19,5                  |
| <b>HC71900-E-T-P4S</b>      | –                      | –                      | 0,012             | <b>10</b>  | 22 | 6 | 0,3 | –              | 25                      | 13                    | 19,5                  |
| <b>XC71900-E-T-P4S</b>      | –                      | –                      | 0,012             | <b>10</b>  | 22 | 6 | 0,3 | –              | 25                      | 13                    | 19,5                  |
| –                           | <b>B7000-C-T-P4S</b>   | –                      | 0,02              | <b>10</b>  | 26 | 8 | 0,3 | 0,3            | 15                      | 14                    | 22                    |
| –                           | <b>B7000-E-T-P4S</b>   | –                      | 0,02              | <b>10</b>  | 26 | 8 | 0,3 | 0,3            | 25                      | 14                    | 22                    |
| –                           | <b>HCB7000-C-T-P4S</b> | –                      | 0,018             | <b>10</b>  | 26 | 8 | 0,3 | 0,3            | 15                      | 14                    | 22                    |
| –                           | <b>HCB7000-E-T-P4S</b> | –                      | 0,018             | <b>10</b>  | 26 | 8 | 0,3 | 0,3            | 25                      | 14                    | 22                    |
| –                           | <b>HS7000-C-T-P4S</b>  | –                      | 0,022             | <b>10</b>  | 26 | 8 | 0,3 | –              | 15                      | 14                    | 22                    |
| –                           | <b>HS7000-E-T-P4S</b>  | –                      | 0,022             | <b>10</b>  | 26 | 8 | 0,3 | –              | 25                      | 14                    | 22                    |
| –                           | <b>HC7000-E-T-P4S</b>  | –                      | 0,023             | <b>10</b>  | 26 | 8 | 0,3 | –              | 25                      | 14                    | 22                    |
| –                           | <b>XC7000-E-T-P4S</b>  | –                      | 0,023             | <b>10</b>  | 26 | 8 | 0,3 | –              | 25                      | 14                    | 22                    |
| –                           | –                      | <b>B7200-C-T-P4S</b>   | 0,032             | <b>10</b>  | 30 | 9 | 0,6 | 0,6            | 15                      | 14,5                  | 25,5                  |
| –                           | –                      | <b>B7200-E-T-P4S</b>   | 0,032             | <b>10</b>  | 30 | 9 | 0,6 | 0,6            | 25                      | 14,5                  | 25,5                  |
| –                           | –                      | <b>HCB7200-C-T-P4S</b> | 0,029             | <b>10</b>  | 30 | 9 | 0,6 | 0,6            | 15                      | 14,5                  | 25,5                  |
| –                           | –                      | <b>HCB7200-E-T-P4S</b> | 0,029             | <b>10</b>  | 30 | 9 | 0,6 | 0,6            | 25                      | 14,5                  | 25,5                  |

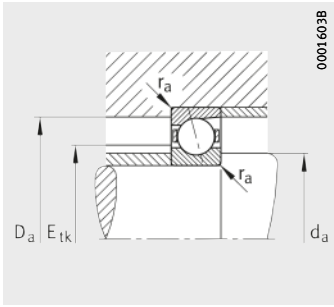
<sup>1)</sup> Explanation of short designations, see page 130.

<sup>2)</sup> The bearings are also available with gap seals (type HSS, HCS, XCS or suffix 2RSD).  
 Ordering examples: B7000-C-2RSD-T-P4S-UL and HSS7000-E-T-P4S-UL.

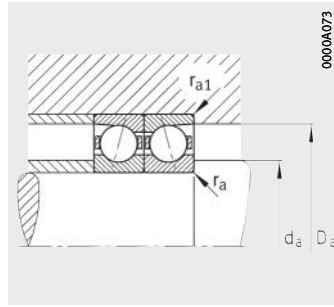
<sup>3)</sup> The limiting speeds in the dimension tables are based on elastically preloaded single bearings.

<sup>4)</sup> Explanation, see page 62.

<sup>5)</sup> Minimal quantity oil lubrication.



Mounting dimensions



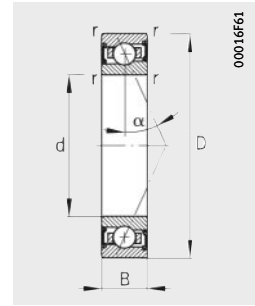
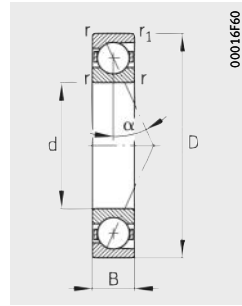
Mounting dimensions



|                |                 |                 | Basic load ratings     |                          | Limiting speeds <sup>3)</sup> |                                  | Preload force <sup>4)</sup><br>F <sub>v</sub> |     |     | Lift-off force <sup>4)</sup><br>K <sub>aE</sub> |     |     | Axial rigidity <sup>4)</sup><br>c <sub>a</sub> |      |       |
|----------------|-----------------|-----------------|------------------------|--------------------------|-------------------------------|----------------------------------|---|-----|-----|---|-----|-----|--|------|-------|
| r <sub>a</sub> | r <sub>a1</sub> | E <sub>tk</sub> | dyn.<br>C <sub>r</sub> | stat.<br>C <sub>0r</sub> | n <sub>G</sub> grease         | n <sub>G</sub> oil <sup>5)</sup> | L   | M   | H   | L   | M   | H   | L  | M    | H     |
| max.           |                 | nom.            | kN                     | kN                       | min <sup>-1</sup>             | min <sup>-1</sup>                | N   | N   | N   | N   | N   | N   | N/μm   | N/μm | N/μm  |
| 0,3            | 0,3             | 15              | 3                      | 1,07                     | 75 000                        | 120 000                          | 10  | 41  | 87  | 31  | 141 | 320 | 11   | 21,1 | 31,2  |
| 0,3            | 0,3             | 15              | 2,9                    | 1,02                     | 70 000                        | 110 000                          | 17  | 74  | 163 | 50  | 226 | 521 | 27,1   | 47,7 | 67    |
| 0,3            | 0,3             | 15              | 3                      | 1,02                     | 110 000                       | 160 000                          | 6   | 25  | 54  | 17  | 79  | 185 | 9,8  | 18,2 | 26,5  |
| 0,3            | 0,3             | 15              | 2,9                    | 0,98                     | 95 000                        | 150 000                          | 5   | 35  | 85  | 16  | 104 | 260 | 20,4   | 39,9 | 56,5  |
| 0,3            | 0,3             | 15              | 1,79                   | 0,65                     | 100 000                       | 160 000                          | 7   | 20  | 39  | 20  | 63  | 132 | 8,8  | 14,1 | 19,6  |
| 0,3            | 0,3             | 15              | 1,7                    | 0,62                     | 95 000                        | 140 000                          | 11  | 32  | 64  | 31  | 96  | 196 | 21,7   | 32,7 | 43    |
| 0,3            | 0,3             | 15              | 1,7                    | 0,6                      | 120 000                       | 180 000                          | 7   | 22  | 45  | 21  | 65  | 133 | 21,6   | 32   | 41,7  |
| 0,3            | 0,3             | 15              | 2,6                    | 0,6                      | 130 000                       | 200 000                          | 7   | 22  | 45  | 21  | 65  | 133 | 21,6   | 32   | 41,7  |
| 0,3            | 0,1             | 16,4            | 4,1                    | 1,47                     | 67 000                        | 100 000                          | 18  | 65  | 136 | 54  | 220 | 490 | 12,7   | 23   | 33,53 |
| 0,3            | 0,1             | 16,4            | 3,95                   | 1,41                     | 60 000                        | 95 000                           | 21  | 99  | 223 | 61  | 298 | 698 | 27,6   | 49,2 | 69,1  |
| 0,3            | 0,1             | 16,4            | 4,1                    | 1,4                      | 95 000                        | 140 000                          | 7   | 33  | 74  | 21  | 104 | 248 | 9,9  | 18,5 | 26,9  |
| 0,3            | 0,1             | 16,4            | 3,95                   | 1,35                     | 85 000                        | 130 000                          | 12  | 57  | 130 | 33  | 167 | 392 | 25,1   | 44,6 | 61,6  |
| 0,3            | 0,1             | 16,8            | 2,47                   | 0,94                     | 90 000                        | 140 000                          | 9   | 28  | 55  | 28  | 89  | 185 | 10,9   | 17,4 | 24,1  |
| 0,3            | 0,1             | 16,8            | 2,35                   | 0,89                     | 85 000                        | 130 000                          | 15  | 45  | 90  | 43  | 133 | 273 | 26,8   | 40,3 | 53    |
| 0,3            | 0,1             | 16,8            | 2,35                   | 0,86                     | 110 000                       | 160 000                          | 10  | 31  | 62  | 30  | 91  | 185 | 26,6   | 39,5 | 51,4  |
| 0,3            | 0,1             | 16,8            | 3,6                    | 0,86                     | 120 000                       | 180 000                          | 10  | 31  | 62  | 30  | 91  | 185 | 26,6   | 39,5 | 51,4  |
| 0,6            | 0,6             | 18,8            | 6,9                    | 2,95                     | 56 000                        | 85 000                           | 25  | 91  | 185 | 79  | 311 | 684 | 16,4   | 29,8 | 43,5  |
| 0,6            | 0,6             | 18,8            | 6,6                    | 2,8                      | 50 000                        | 75 000                           | 32  | 141 | 314 | 94  | 429 | 995 | 35,8   | 63,2 | 88,8  |
| 0,6            | 0,6             | 18,8            | 6,9                    | 2,8                      | 67 000                        | 100 000                          | 11  | 47  | 103 | 32  | 150 | 352 | 12,9   | 23,9 | 34,9  |
| 0,6            | 0,6             | 18,8            | 6,6                    | 2,7                      | 60 000                        | 90 000                           | 18  | 82  | 185 | 52  | 243 | 564 | 32,8   | 57,2 | 71,7  |

# Spindle bearings

With large or small balls  
 Steel or ceramic balls  
 Steel or Cronidur rings  
 Open or sealed



**Dimension table** (continued) · Dimensions in mm

| Designation <sup>1)2)</sup> |                        |                        | Mass<br>m<br>≈ kg | Dimensions |    |    |      |                | Contact angle<br>α<br>° | Mounting dimensions   |                       |
|-----------------------------|------------------------|------------------------|-------------------|------------|----|----|------|----------------|-------------------------|-----------------------|-----------------------|
| Series 719                  | Series 70              | Series 72              |                   | d          | D  | B  | r    | r <sub>1</sub> |                         | d <sub>a</sub><br>h12 | D <sub>a</sub><br>H12 |
|                             |                        |                        |                   |            |    |    | min. |                |                         |                       |                       |
| <b>B71901-C-T-P4S</b>       | –                      | –                      | 0,011             | <b>12</b>  | 24 | 6  | 0,3  | 0,3            | 15                      | 15                    | 21,5                  |
| <b>B71901-E-T-P4S</b>       | –                      | –                      | 0,011             | <b>12</b>  | 24 | 6  | 0,3  | 0,3            | 25                      | 15                    | 21,5                  |
| <b>HCB71901-C-T-P4S</b>     | –                      | –                      | 0,01              | <b>12</b>  | 24 | 6  | 0,3  | 0,3            | 15                      | 15                    | 21,5                  |
| <b>HCB71901-E-T-P4S</b>     | –                      | –                      | 0,01              | <b>12</b>  | 24 | 6  | 0,3  | 0,3            | 25                      | 15                    | 21,5                  |
| <b>HS71901-C-T-P4S</b>      | –                      | –                      | 0,011             | <b>12</b>  | 24 | 6  | 0,3  | –              | 15                      | 15                    | 21,5                  |
| <b>HS71901-E-T-P4S</b>      | –                      | –                      | 0,011             | <b>12</b>  | 24 | 6  | 0,3  | –              | 25                      | 15                    | 21,5                  |
| <b>HC71901-E-T-P4S</b>      | –                      | –                      | 0,013             | <b>12</b>  | 24 | 6  | 0,3  | –              | 25                      | 15                    | 21,5                  |
| <b>XC71901-E-T-P4S</b>      | –                      | –                      | 0,013             | <b>12</b>  | 24 | 6  | 0,3  | –              | 25                      | 15                    | 21,5                  |
| –                           | <b>B7001-C-T-P4S</b>   | –                      | 0,023             | <b>12</b>  | 28 | 8  | 0,3  | 0,3            | 15                      | 16,5                  | 24,5                  |
| –                           | <b>B7001-E-T-P4S</b>   | –                      | 0,023             | <b>12</b>  | 28 | 8  | 0,3  | 0,3            | 25                      | 16,5                  | 24,5                  |
| –                           | <b>HCB7001-C-T-P4S</b> | –                      | 0,02              | <b>12</b>  | 28 | 8  | 0,3  | 0,3            | 15                      | 16,5                  | 24,5                  |
| –                           | <b>HCB7001-E-T-P4S</b> | –                      | 0,02              | <b>12</b>  | 28 | 8  | 0,3  | 0,3            | 25                      | 16,5                  | 24,5                  |
| –                           | <b>HS7001-C-T-P4S</b>  | –                      | 0,024             | <b>12</b>  | 28 | 8  | 0,3  | –              | 15                      | 16,5                  | 24,5                  |
| –                           | <b>HS7001-E-T-P4S</b>  | –                      | 0,024             | <b>12</b>  | 28 | 8  | 0,3  | –              | 25                      | 16,5                  | 24,5                  |
| –                           | <b>HC7001-E-T-P4S</b>  | –                      | 0,025             | <b>12</b>  | 28 | 8  | 0,3  | –              | 25                      | 16,5                  | 24,5                  |
| –                           | <b>XC7001-E-T-P4S</b>  | –                      | 0,025             | <b>12</b>  | 28 | 8  | 0,3  | –              | 25                      | 16,5                  | 24,5                  |
| –                           | –                      | <b>B7201-C-T-P4S</b>   | 0,04              | <b>12</b>  | 32 | 10 | 0,6  | 0,6            | 15                      | 16,5                  | 27,5                  |
| –                           | –                      | <b>B7201-E-T-P4S</b>   | 0,037             | <b>12</b>  | 32 | 10 | 0,6  | 0,6            | 25                      | 16,5                  | 27,5                  |
| –                           | –                      | <b>HCB7201-C-T-P4S</b> | 0,032             | <b>12</b>  | 32 | 10 | 0,6  | 0,6            | 15                      | 16,5                  | 27,5                  |
| –                           | –                      | <b>HCB7201-E-T-P4S</b> | 0,032             | <b>12</b>  | 32 | 10 | 0,6  | 0,6            | 25                      | 16,5                  | 27,5                  |

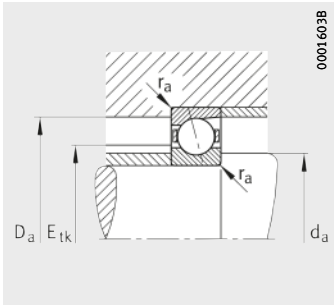
1) Explanation of short designations, see page 130.

2) The bearings are also available with gap seals (type HSS, HCS, XCS or suffix 2RSD).  
 Ordering examples: B7001-C-2RSD-T-P4S-UL and HSS7001-E-T-P4S-UL.

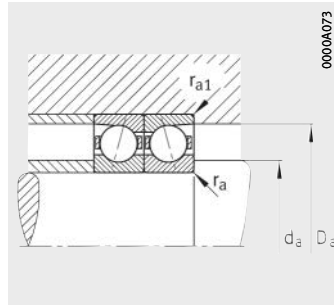
3) The limiting speeds in the dimension tables are based on elastically preloaded single bearings.

4) Explanation, see page 62.

5) Minimal quantity oil lubrication.



Mounting dimensions



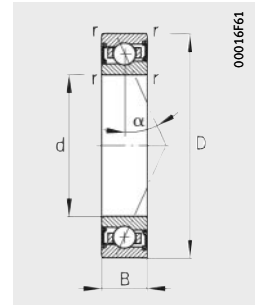
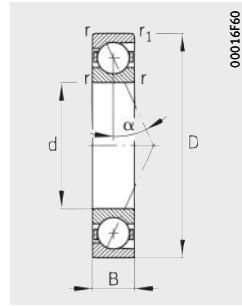
Mounting dimensions



|                |                 |                 | Basic load ratings     |                          |                       | Limiting speeds <sup>3)</sup>    |    | Preload force <sup>4)</sup><br>F <sub>v</sub> |     |     | Lift-off force <sup>4)</sup><br>K <sub>aE</sub> |      |      | Axial rigidity <sup>4)</sup><br>c <sub>a</sub> |       |  |
|----------------|-----------------|-----------------|------------------------|--------------------------|-----------------------|----------------------------------|----|---|-----|-----|---|------|------|--|-------|--|
| r <sub>a</sub> | r <sub>a1</sub> | E <sub>tk</sub> | dyn.<br>C <sub>r</sub> | stat.<br>C <sub>0r</sub> | n <sub>G</sub> grease | n <sub>G</sub> oil <sup>5)</sup> | L  | M   | H   | L   | M   | H    | L    | M  | H     |  |
| max.           |                 | nom.            | kN                     | kN                       | min <sup>-1</sup>     | min <sup>-1</sup>                | N  | N   | N   | N   | N   | N    | N/μm | N/μm   | N/μm  |  |
| 0,3            | 0,3             | 17,2            | 3,4                    | 1,31                     | 67 000                | 100 000                          | 11 | 46  | 97  | 34  | 155   | 355  | 12,6 | 24,1   | 35,7  |  |
| 0,3            | 0,3             | 17,2            | 3,25                   | 1,25                     | 60 000                | 95 000                           | 18 | 80  | 179 | 53  | 245   | 567  | 30,8 | 54,4   | 76,5  |  |
| 0,3            | 0,3             | 17,2            | 3,4                    | 1,25                     | 95 000                | 140 000                          | 6  | 27  | 60  | 18  | 87  | 205  | 11,2 | 20,8   | 30,3  |  |
| 0,3            | 0,3             | 17,2            | 3,25                   | 1,19                     | 85 000                | 130 000                          | 5  | 38  | 92  | 16  | 111   | 281  | 22,7 | 45,5   | 64,5  |  |
| 0,3            | 0,3             | 17              | 1,85                   | 0,72                     | 90 000                | 140 000                          | 7  | 21  | 41  | 21  | 66  | 137  | 9,4  | 15   | 20,8  |  |
| 0,3            | 0,3             | 17              | 1,76                   | 0,69                     | 85 000                | 130 000                          | 11 | 33  | 67  | 32  | 99  | 203  | 23,1 | 34,7   | 45,6  |  |
| 0,3            | 0,3             | 17              | 1,76                   | 0,66                     | 110 000               | 160 000                          | 8  | 23  | 46  | 22  | 68  | 138  | 22,9 | 34,1   | 44,3  |  |
| 0,3            | 0,3             | 17              | 2,7                    | 0,66                     | 120 000               | 180 000                          | 8  | 23  | 46  | 22  | 68  | 138  | 22,9 | 34,1   | 44,3  |  |
| 0,3            | 0,1             | 18,6            | 4,65                   | 1,83                     | 60 000                | 90 000                           | 19 | 73  | 152 | 59  | 242   | 543  | 14,6 | 26,5   | 38,71 |  |
| 0,3            | 0,1             | 18,6            | 4,45                   | 1,75                     | 53 000                | 85 000                           | 23 | 109   | 248 | 66  | 328   | 775  | 31,8 | 57,2   | 80,3  |  |
| 0,3            | 0,1             | 18,6            | 4,65                   | 1,75                     | 85 000                | 130 000                          | 8  | 36  | 82  | 22  | 114   | 274  | 11,3 | 21,4   | 31,1  |  |
| 0,3            | 0,1             | 18,6            | 4,45                   | 1,67                     | 75 000                | 120 000                          | 12 | 63  | 145 | 35  | 184   | 436  | 29   | 51,9   | 71,7  |  |
| 0,3            | 0,1             | 18,8            | 2,45                   | 0,96                     | 80 000                | 130 000                          | 9  | 27  | 54  | 27  | 87  | 181  | 10,8 | 17,3   | 23,9  |  |
| 0,3            | 0,1             | 18,8            | 2,32                   | 0,91                     | 75 000                | 110 000                          | 15 | 44  | 88  | 43  | 131   | 268  | 26,7 | 40   | 52,6  |  |
| 0,3            | 0,1             | 18,8            | 2,32                   | 0,87                     | 95 000                | 140 000                          | 10 | 30  | 61  | 29  | 89  | 181  | 26,4 | 39,2   | 50,9  |  |
| 0,3            | 0,1             | 18,8            | 3,55                   | 0,87                     | 100 000               | 160 000                          | 10 | 30  | 61  | 29  | 89  | 181  | 26,4 | 39,2   | 50,9  |  |
| 0,6            | 0,6             | 21,1            | 9,1                    | 3,9                      | 50 000                | 75 000                           | 35 | 123   | 248 | 109 | 420   | 916  | 19,3 | 34,6   | 50,3  |  |
| 0,6            | 0,6             | 21,1            | 8,8                    | 3,75                     | 45 000                | 67 000                           | 47 | 193   | 423 | 137 | 588   | 1342 | 42,8 | 73,9   | 103,1 |  |
| 0,6            | 0,6             | 21,1            | 9,1                    | 3,7                      | 63 000                | 95 000                           | 16 | 65  | 142 | 47  | 210   | 483  | 15,6 | 28,2   | 40,9  |  |
| 0,6            | 0,6             | 21,1            | 8,8                    | 3,6                      | 53 000                | 80 000                           | 26 | 112   | 248 | 76  | 332   | 757  | 39,2 | 66,8   | 84,3  |  |

# Spindle bearings

With large or small balls  
 Steel or ceramic balls  
 Steel or Cronidur rings  
 Open or sealed



**Dimension table** (continued) · Dimensions in mm

| Designation <sup>1)2)</sup> |                        |                        | Mass<br>m<br>≈ kg | Dimensions |    |    |     |                | Contact<br>angle<br>α<br>° | Mounting<br>dimensions |                       |
|-----------------------------|------------------------|------------------------|-------------------|------------|----|----|-----|----------------|----------------------------|------------------------|-----------------------|
| Series 719                  | Series 70              | Series 72              |                   | d          | D  | B  | r   | r <sub>1</sub> |                            | d <sub>a</sub><br>h12  | D <sub>a</sub><br>H12 |
| <b>B71902-C-T-P4S</b>       | –                      | –                      | 0,016             | <b>15</b>  | 28 | 7  | 0,3 | 0,3            | 15                         | 18                     | 25,5                  |
| <b>B71902-E-T-P4S</b>       | –                      | –                      | 0,016             | <b>15</b>  | 28 | 7  | 0,3 | 0,3            | 25                         | 18                     | 25,5                  |
| <b>HCB71902-C-T-P4S</b>     | –                      | –                      | 0,014             | <b>15</b>  | 28 | 7  | 0,3 | 0,3            | 15                         | 18                     | 25,5                  |
| <b>HCB71902-E-T-P4S</b>     | –                      | –                      | 0,014             | <b>15</b>  | 28 | 7  | 0,3 | 0,3            | 25                         | 18                     | 25,5                  |
| <b>HS71902-C-T-P4S</b>      | –                      | –                      | 0,017             | <b>15</b>  | 28 | 7  | 0,3 | –              | 15                         | 18                     | 25,5                  |
| <b>HS71902-E-T-P4S</b>      | –                      | –                      | 0,017             | <b>15</b>  | 28 | 7  | 0,3 | –              | 25                         | 18                     | 25,5                  |
| <b>HC71902-E-T-P4S</b>      | –                      | –                      | 0,018             | <b>15</b>  | 28 | 7  | 0,3 | –              | 25                         | 18                     | 25,5                  |
| <b>XC71902-E-T-P4S</b>      | –                      | –                      | 0,018             | <b>15</b>  | 28 | 7  | 0,3 | –              | 25                         | 18                     | 25,5                  |
| –                           | <b>B7002-C-T-P4S</b>   | –                      | 0,03              | <b>15</b>  | 32 | 9  | 0,3 | 0,3            | 15                         | 19                     | 29                    |
| –                           | <b>B7002-E-T-P4S</b>   | –                      | 0,03              | <b>15</b>  | 32 | 9  | 0,3 | 0,3            | 25                         | 19                     | 29                    |
| –                           | <b>HCB7002-C-T-P4S</b> | –                      | 0,027             | <b>15</b>  | 32 | 9  | 0,3 | 0,3            | 15                         | 19                     | 29                    |
| –                           | <b>HCB7002-E-T-P4S</b> | –                      | 0,027             | <b>15</b>  | 32 | 9  | 0,3 | 0,3            | 25                         | 19                     | 29                    |
| –                           | <b>HS7002-C-T-P4S</b>  | –                      | 0,033             | <b>15</b>  | 32 | 9  | 0,3 | –              | 15                         | 19                     | 29                    |
| –                           | <b>HS7002-E-T-P4S</b>  | –                      | 0,033             | <b>15</b>  | 32 | 9  | 0,3 | –              | 25                         | 19                     | 29                    |
| –                           | <b>HC7002-E-T-P4S</b>  | –                      | 0,035             | <b>15</b>  | 32 | 9  | 0,3 | –              | 25                         | 19                     | 29                    |
| –                           | <b>XC7002-E-T-P4S</b>  | –                      | 0,035             | <b>15</b>  | 32 | 9  | 0,3 | –              | 25                         | 19                     | 29                    |
| –                           | –                      | <b>B7202-C-T-P4S</b>   | 0,044             | <b>15</b>  | 35 | 11 | 0,6 | 0,6            | 15                         | 19,5                   | 30,5                  |
| –                           | –                      | <b>B7202-E-T-P4S</b>   | 0,044             | <b>15</b>  | 35 | 11 | 0,6 | 0,6            | 25                         | 19,5                   | 30,5                  |
| –                           | –                      | <b>HCB7202-C-T-P4S</b> | 0,038             | <b>15</b>  | 35 | 11 | 0,6 | 0,6            | 15                         | 19,5                   | 30,5                  |
| –                           | –                      | <b>HCB7202-E-T-P4S</b> | 0,038             | <b>15</b>  | 35 | 11 | 0,6 | 0,6            | 25                         | 19,5                   | 30,5                  |

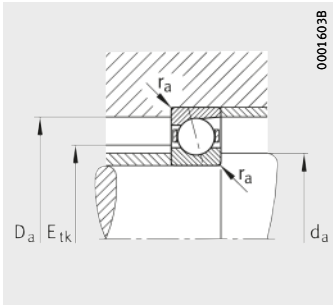
1) Explanation of short designations, see page 130.

2) The bearings are also available with gap seals (type HSS, HCS, XCS or suffix 2RSD).  
 Ordering examples: B7002-C-2RSD-T-P4S-UL and HSS7002-E-T-P4S-UL.

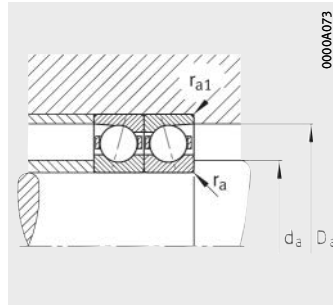
3) The limiting speeds in the dimension tables are based on elastically preloaded single bearings.

4) Explanation, see page 62.

5) Minimal quantity oil lubrication.



Mounting dimensions



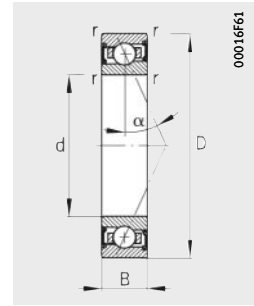
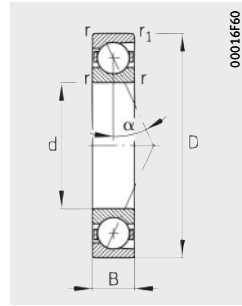
Mounting dimensions



|                |                 |                 | Basic load ratings     |                          | Limiting speeds <sup>3)</sup> |                                  | Preload force <sup>4)</sup><br>F <sub>V</sub> |     |     | Lift-off force <sup>4)</sup><br>K <sub>aE</sub> |     |      | Axial rigidity <sup>4)</sup><br>c <sub>a</sub> |      |       |
|----------------|-----------------|-----------------|------------------------|--------------------------|-------------------------------|----------------------------------|---|-----|-----|---|-----|------|--|------|-------|
| r <sub>a</sub> | r <sub>a1</sub> | E <sub>tk</sub> | dyn.<br>C <sub>r</sub> | stat.<br>C <sub>0r</sub> | n <sub>G</sub> grease         | n <sub>G</sub> oil <sup>5)</sup> | L   | M   | H   | L   | M   | H    | L  | M    | H     |
| max.           |                 | nom.            | kN                     | kN                       | min <sup>-1</sup>             | min <sup>-1</sup>                | N   | N   | N   | N   | N   | N    | N/μm   | N/μm | N/μm  |
| 0,3            | 0,3             | 20,9            | 5,1                    | 2,03                     | 56 000                        | 85 000                           | 19  | 73  | 153 | 59  | 249 | 559  | 16,4   | 30,5 | 44,9  |
| 0,3            | 0,3             | 20,9            | 4,85                   | 1,94                     | 50 000                        | 75 000                           | 22  | 111 | 255 | 64  | 336 | 805  | 35   | 64,7 | 91,9  |
| 0,3            | 0,3             | 20,9            | 5,1                    | 1,94                     | 75 000                        | 120 000                          | 7   | 37  | 84  | 21  | 117 | 285  | 12,5   | 24,4 | 35,9  |
| 0,3            | 0,3             | 20,9            | 4,85                   | 1,86                     | 70 000                        | 110 000                          | 12  | 64  | 150 | 34  | 190 | 457  | 31,9   | 58,7 | 82    |
| 0,3            | 0,3             | 20,3            | 2,55                   | 1,04                     | 75 000                        | 110 000                          | 9   | 28  | 56  | 28  | 90  | 188  | 11,4   | 18,2 | 25,2  |
| 0,3            | 0,3             | 20,3            | 2,41                   | 0,99                     | 67 000                        | 100 000                          | 15  | 46  | 91  | 44  | 136 | 278  | 28,3   | 42,4 | 55,6  |
| 0,3            | 0,3             | 20,3            | 2,41                   | 0,95                     | 85 000                        | 130 000                          | 11  | 32  | 63  | 30  | 92  | 188  | 28   | 41,5 | 53,9  |
| 0,3            | 0,3             | 20,3            | 3,7                    | 0,95                     | 95 000                        | 150 000                          | 11  | 32  | 63  | 30  | 92  | 188  | 28   | 41,5 | 53,9  |
| 0,3            | 0,1             | 22,3            | 6,1                    | 2,41                     | 53 000                        | 80 000                           | 27  | 99  | 204 | 84  | 332 | 733  | 16,6   | 29,7 | 43,04 |
| 0,3            | 0,1             | 22,3            | 5,9                    | 2,31                     | 45 000                        | 70 000                           | 36  | 154 | 341 | 104   | 464 | 1066 | 37,2   | 64,6 | 89,8  |
| 0,3            | 0,1             | 22,3            | 6,1                    | 2,31                     | 70 000                        | 110 000                          | 12  | 52  | 114 | 35  | 164 | 381  | 13,4   | 24,3 | 35,1  |
| 0,3            | 0,1             | 22,3            | 5,9                    | 2,21                     | 63 000                        | 100 000                          | 20  | 88  | 199 | 57  | 260 | 600  | 34,1   | 58,6 | 80,2  |
| 0,3            | 0,1             | 22,2            | 3,45                   | 1,48                     | 70 000                        | 110 000                          | 13  | 38  | 75  | 38  | 120 | 251  | 13,7   | 21,8 | 30,2  |
| 0,3            | 0,1             | 22,2            | 3,25                   | 1,41                     | 63 000                        | 95 000                           | 20  | 61  | 122 | 59  | 182 | 372  | 34   | 50,9 | 66,8  |
| 0,3            | 0,1             | 22,2            | 3,25                   | 1,35                     | 80 000                        | 120 000                          | 14  | 42  | 85  | 41  | 124 | 252  | 33,7   | 49,9 | 64,8  |
| 0,3            | 0,1             | 22,2            | 5                      | 1,35                     | 90 000                        | 140 000                          | 14  | 42  | 85  | 41  | 124 | 252  | 33,7   | 49,9 | 64,8  |
| 0,6            | 0,6             | 23,3            | 11,6                   | 5                        | 45 000                        | 67 000                           | 46  | 158 | 319 | 144   | 543 | 1177 | 22,1   | 39,3 | 57    |
| 0,6            | 0,6             | 23,3            | 11,1                   | 4,85                     | 40 000                        | 60 000                           | 64  | 252 | 546 | 187   | 768 | 1732 | 49,7   | 84,4 | 117,3 |
| 0,6            | 0,6             | 23,3            | 11,6                   | 4,8                      | 56 000                        | 85 000                           | 22  | 86  | 183 | 65  | 275 | 626  | 18,1   | 32,3 | 46,5  |
| 0,6            | 0,6             | 23,3            | 11,1                   | 4,65                     | 48 000                        | 70 000                           | 24  | 126 | 291 | 70  | 371 | 884  | 39,7   | 72   | 89,1  |

# Spindle bearings

With large or small balls  
 Steel or ceramic balls  
 Steel or Cronidur rings  
 Open or sealed



**Dimension table** (continued) · Dimensions in mm

| Designation <sup>1)2)</sup> |                        |                        | Mass<br>m<br>≈ kg | Dimensions |    |    |     |                | Contact angle<br>α<br>° | Mounting dimensions   |                       |
|-----------------------------|------------------------|------------------------|-------------------|------------|----|----|-----|----------------|-------------------------|-----------------------|-----------------------|
| Series 719                  | Series 70              | Series 72              |                   | d          | D  | B  | r   | r <sub>1</sub> |                         | d <sub>a</sub><br>h12 | D <sub>a</sub><br>H12 |
| <b>B71903-C-T-P4S</b>       | –                      | –                      | 0,018             | 17         | 30 | 7  | 0,3 | 0,3            | 15                      | 20                    | 27,5                  |
| <b>B71903-E-T-P4S</b>       | –                      | –                      | 0,018             | 17         | 30 | 7  | 0,3 | 0,3            | 25                      | 20                    | 27,5                  |
| <b>HCB71903-C-T-P4S</b>     | –                      | –                      | 0,015             | 17         | 30 | 7  | 0,3 | 0,3            | 15                      | 20                    | 27,5                  |
| <b>HCB71903-E-T-P4S</b>     | –                      | –                      | 0,015             | 17         | 30 | 7  | 0,3 | 0,3            | 25                      | 20                    | 27,5                  |
| <b>HS71903-C-T-P4S</b>      | –                      | –                      | 0,019             | 17         | 30 | 7  | 0,3 | –              | 15                      | 20                    | 27,5                  |
| <b>HS71903-E-T-P4S</b>      | –                      | –                      | 0,019             | 17         | 30 | 7  | 0,3 | –              | 25                      | 20                    | 27,5                  |
| <b>HC71903-E-T-P4S</b>      | –                      | –                      | 0,021             | 17         | 30 | 7  | 0,3 | –              | 25                      | 20                    | 27,5                  |
| <b>XC71903-E-T-P4S</b>      | –                      | –                      | 0,021             | 17         | 30 | 7  | 0,3 | –              | 25                      | 20                    | 27,5                  |
| –                           | <b>B7003-C-T-P4S</b>   | –                      | 0,039             | 17         | 35 | 10 | 0,3 | 0,3            | 15                      | 21                    | 32                    |
| –                           | <b>B7003-E-T-P4S</b>   | –                      | 0,038             | 17         | 35 | 10 | 0,3 | 0,3            | 25                      | 21                    | 32                    |
| –                           | <b>HCB7003-C-T-P4S</b> | –                      | 0,033             | 17         | 35 | 10 | 0,3 | 0,3            | 15                      | 21                    | 32                    |
| –                           | <b>HCB7003-E-T-P4S</b> | –                      | 0,032             | 17         | 35 | 10 | 0,3 | 0,3            | 25                      | 21                    | 32                    |
| –                           | <b>HS7003-C-T-P4S</b>  | –                      | 0,043             | 17         | 35 | 10 | 0,3 | –              | 15                      | 21                    | 32                    |
| –                           | <b>HS7003-E-T-P4S</b>  | –                      | 0,043             | 17         | 35 | 10 | 0,3 | –              | 25                      | 21                    | 32                    |
| –                           | <b>HC7003-E-T-P4S</b>  | –                      | 0,046             | 17         | 35 | 10 | 0,3 | –              | 25                      | 21                    | 32                    |
| –                           | <b>XC7003-E-T-P4S</b>  | –                      | 0,046             | 17         | 35 | 10 | 0,3 | –              | 25                      | 21                    | 32                    |
| –                           | –                      | <b>B7203-C-T-P4S</b>   | 0,063             | 17         | 40 | 12 | 0,6 | 0,6            | 15                      | 22,5                  | 34,5                  |
| –                           | –                      | <b>B7203-E-T-P4S</b>   | 0,062             | 17         | 40 | 12 | 0,6 | 0,6            | 25                      | 22,5                  | 34,5                  |
| –                           | –                      | <b>HCB7203-C-T-P4S</b> | 0,056             | 17         | 40 | 12 | 0,6 | 0,6            | 15                      | 22,5                  | 34,5                  |
| –                           | –                      | <b>HCB7203-E-T-P4S</b> | 0,055             | 17         | 40 | 12 | 0,6 | 0,6            | 25                      | 22,5                  | 34,5                  |

<sup>1)</sup> Explanation of short designations, see page 130.

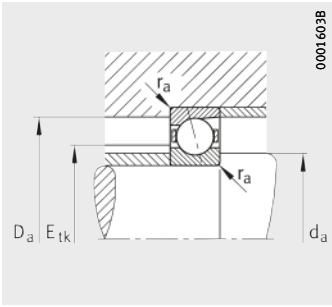
<sup>2)</sup> The bearings are also available with gap seals (type HSS, HCS, XCS or suffix 2RSD).  
 Ordering examples: B7003-C-2RSD-T-P4S-UL and HSS7003-E-T-P4S-UL.

<sup>3)</sup> The limiting speeds in the dimension tables are based on elastically preloaded single bearings.

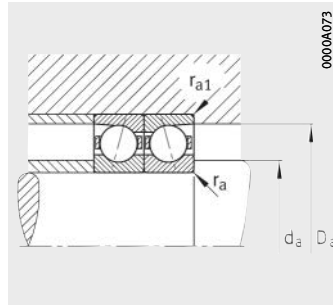
<sup>4)</sup> Explanation, see page 62.

<sup>5)</sup> Minimal quantity oil lubrication.





Mounting dimensions



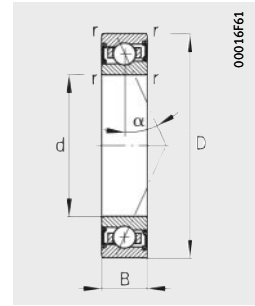
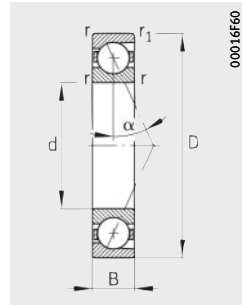
Mounting dimensions



|                |                 |                 | Basic load ratings     |                          | Limiting speeds <sup>3)</sup> |                                  | Preload force <sup>4)</sup><br>F <sub>v</sub> |     |     | Lift-off force <sup>4)</sup><br>K <sub>aE</sub> |     |       | Axial rigidity <sup>4)</sup><br>c <sub>a</sub> |      |       |
|----------------|-----------------|-----------------|------------------------|--------------------------|-------------------------------|----------------------------------|---|-----|-----|---|-----|-------|--|------|-------|
| r <sub>a</sub> | r <sub>a1</sub> | E <sub>tk</sub> | dyn.<br>C <sub>r</sub> | stat.<br>C <sub>0r</sub> | n <sub>G</sub> grease         | n <sub>G</sub> oil <sup>5)</sup> | L   | M   | H   | L   | M   | H     | L  | M    | H     |
| max.           |                 | nom.            | kN                     | kN                       | min <sup>-1</sup>             | min <sup>-1</sup>                | N   | N   | N   | N   | N   | N     | N/μm   | N/μm | N/μm  |
| 0,3            | 0,3             | 22,2            | 5,3                    | 2,23                     | 50 000                        | 80 000                           | 20  | 78  | 162 | 62  | 263 | 592   | 17,5   | 32,6 | 47,9  |
| 0,3            | 0,3             | 22,2            | 5,1                    | 2,12                     | 45 000                        | 70 000                           | 22  | 115 | 265 | 65  | 346 | 833   | 36,9   | 68,5 | 97,3  |
| 0,3            | 0,3             | 22,2            | 5,3                    | 2,13                     | 70 000                        | 110 000                          | 8   | 39  | 89  | 22  | 123 | 300   | 13,3   | 26   | 38,3  |
| 0,3            | 0,3             | 22,2            | 5,1                    | 2,03                     | 63 000                        | 100 000                          | 12  | 65  | 154 | 34  | 193 | 466   | 33,4   | 61,9 | 86,4  |
| 0,3            | 0,3             | 22,3            | 2,6                    | 1,13                     | 70 000                        | 110 000                          | 10  | 29  | 58  | 29  | 93  | 194   | 12   | 19,2 | 26,5  |
| 0,3            | 0,3             | 22,3            | 2,48                   | 1,07                     | 63 000                        | 95 000                           | 16  | 47  | 93  | 45  | 138 | 283   | 29,6   | 44,4 | 58,3  |
| 0,3            | 0,3             | 22,3            | 2,48                   | 1,03                     | 80 000                        | 120 000                          | 11  | 33  | 66  | 31  | 96  | 195   | 29,6   | 43,9 | 56,9  |
| 0,3            | 0,3             | 22,3            | 3,8                    | 1,03                     | 90 000                        | 140 000                          | 11  | 33  | 66  | 31  | 96  | 195   | 29,6   | 43,9 | 56,9  |
| 0,3            | 0,1             | 24,1            | 8,6                    | 3,5                      | 45 000                        | 70 000                           | 40  | 142 | 291 | 124   | 474 | 1 042 | 21,1   | 37,1 | 53,61 |
| 0,3            | 0,1             | 24,1            | 8,2                    | 3,35                     | 43 000                        | 63 000                           | 54  | 220 | 483 | 156   | 663 | 1 504 | 47,6   | 81   | 111,9 |
| 0,3            | 0,1             | 24,1            | 8,6                    | 3,35                     | 63 000                        | 100 000                          | 18  | 75  | 164 | 54  | 237 | 546   | 17,3   | 30,7 | 43,9  |
| 0,3            | 0,1             | 24,1            | 8,2                    | 3,25                     | 56 000                        | 90 000                           | 30  | 126 | 279 | 85  | 370 | 840   | 43,5   | 73,4 | 99,7  |
| 0,3            | 0,1             | 24,7            | 3,55                   | 1,6                      | 63 000                        | 95 000                           | 13  | 38  | 76  | 38  | 121 | 253   | 14,3   | 22,7 | 31,3  |
| 0,3            | 0,1             | 24,7            | 3,35                   | 1,52                     | 56 000                        | 85 000                           | 21  | 63  | 126 | 61  | 187 | 382   | 35,7   | 53,4 | 70    |
| 0,3            | 0,1             | 24,7            | 3,35                   | 1,46                     | 75 000                        | 110 000                          | 14  | 43  | 86  | 41  | 126 | 256   | 35,3   | 52,2 | 67,7  |
| 0,3            | 0,1             | 24,7            | 5,1                    | 1,46                     | 80 000                        | 120 000                          | 14  | 43  | 86  | 41  | 126 | 256   | 35,3   | 52,2 | 67,7  |
| 0,6            | 0,6             | 26,7            | 13                     | 5,8                      | 38 000                        | 56 000                           | 53  | 179 | 360 | 165   | 614 | 1 327 | 23,6   | 41,8 | 60,6  |
| 0,6            | 0,6             | 26,7            | 12,4                   | 5,6                      | 36 000                        | 53 000                           | 74  | 286 | 616 | 216   | 871 | 1 954 | 53,3   | 89,9 | 124,6 |
| 0,6            | 0,6             | 26,7            | 13                     | 5,6                      | 50 000                        | 75 000                           | 25  | 97  | 208 | 75  | 313 | 708   | 19,5   | 34,4 | 49,5  |
| 0,6            | 0,6             | 26,7            | 12,4                   | 5,4                      | 43 000                        | 63 000                           | 29  | 145 | 332 | 84  | 428 | 1 011 | 43,2   | 77,2 | 95,9  |

# Spindle bearings

With large or small balls  
 Steel or ceramic balls  
 Steel or Cronidur rings  
 Open or sealed  
 Design DLR



**Dimension table** (continued) · Dimensions in mm

| Designation <sup>1)2)</sup> |                        |                        | Mass<br>m<br>≈ kg | Dimensions |    |    |     |                |                |                |                | Contact<br>angle<br>α<br>° |
|-----------------------------|------------------------|------------------------|-------------------|------------|----|----|-----|----------------|----------------|----------------|----------------|----------------------------|
| Series 719                  | Series 70              | Series 72              |                   | d          | D  | B  | r   | r <sub>1</sub> | B <sub>N</sub> | S <sub>N</sub> | S <sub>B</sub> |                            |
| <b>B71904-C-T-P4S</b>       | –                      | –                      | 0,037             | <b>20</b>  | 37 | 9  | 0,3 | 0,3            | –              | –              | –              | 15                         |
| <b>B71904-E-T-P4S</b>       | –                      | –                      | 0,037             | <b>20</b>  | 37 | 9  | 0,3 | 0,3            | –              | –              | –              | 25                         |
| <b>HCB71904-C-T-P4S</b>     | –                      | –                      | 0,033             | <b>20</b>  | 37 | 9  | 0,3 | 0,3            | –              | –              | –              | 15                         |
| <b>HCB71904-E-T-P4S</b>     | –                      | –                      | 0,033             | <b>20</b>  | 37 | 9  | 0,3 | 0,3            | –              | –              | –              | 25                         |
| <b>HS71904-C-T-P4S</b>      | –                      | –                      | 0,04              | <b>20</b>  | 37 | 9  | 0,3 | –              | –              | –              | –              | 15                         |
| <b>HS71904-E-T-P4S</b>      | –                      | –                      | 0,04              | <b>20</b>  | 37 | 9  | 0,3 | –              | –              | –              | –              | 25                         |
| <b>HC71904-E-T-P4S</b>      | –                      | –                      | 0,045             | <b>20</b>  | 37 | 9  | 0,3 | –              | –              | –              | –              | 25                         |
| <b>XC71904-E-T-P4S</b>      | –                      | –                      | 0,045             | <b>20</b>  | 37 | 9  | 0,3 | –              | –              | –              | –              | 25                         |
| –                           | <b>B7004-C-T-P4S</b>   | –                      | 0,067             | <b>20</b>  | 42 | 12 | 0,6 | 0,6            | –              | –              | –              | 15                         |
| –                           | <b>B7004-E-T-P4S</b>   | –                      | 0,067             | <b>20</b>  | 42 | 12 | 0,6 | 0,6            | –              | –              | –              | 25                         |
| –                           | <b>HCB7004-C-T-P4S</b> | –                      | 0,061             | <b>20</b>  | 42 | 12 | 0,6 | 0,6            | 2,2            | 6,6            | 1,4            | 15                         |
| –                           | <b>HCB7004-E-T-P4S</b> | –                      | 0,06              | <b>20</b>  | 42 | 12 | 0,6 | 0,6            | 2,2            | 6,6            | 1,4            | 25                         |
| –                           | <b>RS7004-D-T-P4S</b>  | –                      | 0,07              | <b>20</b>  | 42 | 12 | 0,6 | 0,6            | –              | –              | –              | 20                         |
| –                           | <b>HS7004-C-T-P4S</b>  | –                      | 0,077             | <b>20</b>  | 42 | 12 | 0,6 | –              | –              | –              | –              | 15                         |
| –                           | <b>HS7004-E-T-P4S</b>  | –                      | 0,077             | <b>20</b>  | 42 | 12 | 0,6 | –              | –              | –              | –              | 25                         |
| –                           | <b>HC7004-E-T-P4S</b>  | –                      | 0,079             | <b>20</b>  | 42 | 12 | 0,6 | –              | 2,2            | 6,6            | 1,4            | 25                         |
| –                           | <b>XC7004-E-T-P4S</b>  | –                      | 0,079             | <b>20</b>  | 42 | 12 | 0,6 | –              | 2,2            | 6,6            | 1,4            | 25                         |
| –                           | –                      | <b>B7204-C-T-P4S</b>   | 0,103             | <b>20</b>  | 47 | 14 | 1   | 1              | –              | –              | –              | 15                         |
| –                           | –                      | <b>B7204-E-T-P4S</b>   | 0,103             | <b>20</b>  | 47 | 14 | 1   | 1              | –              | –              | –              | 25                         |
| –                           | –                      | <b>HCB7204-C-T-P4S</b> | 0,092             | <b>20</b>  | 47 | 14 | 1   | 1              | –              | –              | –              | 15                         |
| –                           | –                      | <b>HCB7204-E-T-P4S</b> | 0,091             | <b>20</b>  | 47 | 14 | 1   | 1              | –              | –              | –              | 25                         |

<sup>1)</sup> Explanation of short designations, see page 130.

<sup>2)</sup> The bearings are also available with gap seals (type HSS, HCS, XCS or suffix 2RSD).

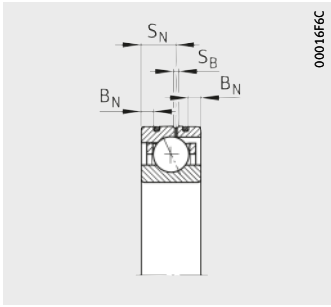
Ordering examples: B7004-C-2RSD-T-P4S-UL and HSS7004-E-T-P4S-UL.

<sup>3)</sup> The limiting speeds in the dimension tables are based on elastically preloaded single bearings.

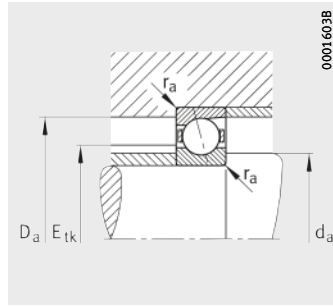
<sup>4)</sup> Explanation, see page 62.

<sup>5)</sup> Minimal quantity oil lubrication.

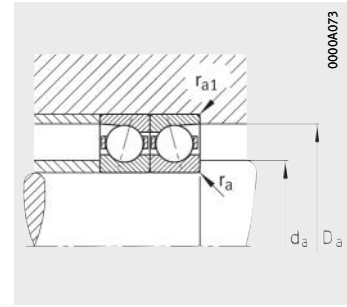
<sup>6)</sup> Ordering examples for Direct Lube design: HCB7004-EDLR-T-P4S-UL and HC7004-EDLR-T-P4S-UL.  
DLR only up to bore code 22.



Design DLR<sup>6)</sup>



Mounting dimensions



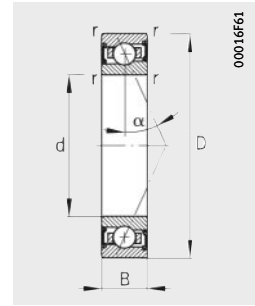
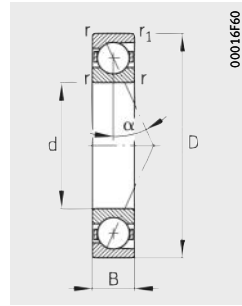
Mounting dimensions



| Mounting dimensions   |                       |                |                 |                 | Basic load ratings     |                          | Limiting speeds <sup>3)</sup> |                                  | Preload force <sup>4)</sup> |      |      | Lift-off force <sup>4)</sup> |       |       | Axial rigidity <sup>4)</sup> |      |       |
|-----------------------|-----------------------|----------------|-----------------|-----------------|------------------------|--------------------------|-------------------------------|----------------------------------|-----------------------------|------|------|------------------------------|-------|-------|------------------------------|------|-------|
| d <sub>a</sub><br>h12 | D <sub>a</sub><br>H12 | r <sub>a</sub> | r <sub>a1</sub> | E <sub>tk</sub> | dyn.<br>C <sub>r</sub> | stat.<br>C <sub>0r</sub> | n <sub>G</sub> grease         | n <sub>G</sub> oil <sup>5)</sup> | F <sub>v</sub>              |      |      | K <sub>aE</sub>              |       |       | c <sub>a</sub>               |      |       |
|                       |                       | max.           |                 | nom.            | kN                     | kN                       | min <sup>-1</sup>             | min <sup>-1</sup>                | L                           | M    | H    | L                            | M     | H     | N                            | M    | H     |
|                       |                       |                |                 |                 |                        |                          |                               |                                  | N                           | N    | N    | N                            | N     | N     | N                            | N    | N     |
|                       |                       |                |                 |                 |                        |                          |                               |                                  | N/μm                        | N/μm | N/μm | N/μm                         | N/μm  | N/μm  | N/μm                         | N/μm | N/μm  |
| 24                    | 33,5                  | 0,3            | 0,3             | 26,8            | 7,4                    | 3,2                      | 43 000                        | 63 000                           | 31                          | 113  | 233  | 95                           | 384   | 851   | 21,6                         | 39,3 | 57,4  |
| 24                    | 33,5                  | 0,3            | 0,3             | 26,8            | 7                      | 3,05                     | 38 000                        | 60 000                           | 37                          | 170  | 384  | 108                          | 516   | 1 208 | 46,7                         | 83,3 | 117,1 |
| 24                    | 33,5                  | 0,3            | 0,3             | 26,8            | 7,4                    | 3,1                      | 60 000                        | 90 000                           | 12                          | 57   | 128  | 37                           | 182   | 431   | 16,8                         | 31,5 | 46    |
| 24                    | 33,5                  | 0,3            | 0,3             | 26,8            | 7                      | 2,95                     | 53 000                        | 80 000                           | 20                          | 98   | 223  | 58                           | 289   | 678   | 42,5                         | 75,3 | 104,1 |
| 24                    | 33,5                  | 0,3            | 0,3             | 27,2            | 3,6                    | 1,73                     | 56 000                        | 90 000                           | 13                          | 39   | 78   | 39                           | 124   | 259   | 15                           | 23,7 | 32,7  |
| 24                    | 33,5                  | 0,3            | 0,3             | 27,2            | 3,4                    | 1,63                     | 53 000                        | 80 000                           | 22                          | 65   | 129  | 62                           | 191   | 392   | 37,4                         | 55,9 | 73,2  |
| 24                    | 33,5                  | 0,3            | 0,3             | 27,2            | 3,4                    | 1,56                     | 67 000                        | 100 000                          | 15                          | 44   | 88   | 42                           | 128   | 261   | 36,9                         | 54,6 | 70,7  |
| 24                    | 33,5                  | 0,3            | 0,3             | 27,2            | 5,2                    | 1,56                     | 75 000                        | 110 000                          | 15                          | 44   | 88   | 42                           | 128   | 261   | 36,9                         | 54,6 | 70,7  |
| 25                    | 37                    | 0,6            | 0,3             | 28,8            | 10,3                   | 4,25                     | 38 000                        | 60 000                           | 51                          | 175  | 356  | 157                          | 586   | 1 276 | 22,6                         | 39,4 | 56,8  |
| 25                    | 37                    | 0,6            | 0,3             | 28,8            | 9,8                    | 4,05                     | 34 000                        | 53 000                           | 71                          | 275  | 595  | 205                          | 829   | 1 857 | 51,6                         | 86,3 | 118,7 |
| 25                    | 37                    | 0,6            | 0,3             | 28,8            | 10,3                   | 4,05                     | 53 000                        | 80 000                           | 24                          | 94   | 202  | 72                           | 297   | 673   | 18,7                         | 32,7 | 46,6  |
| 25                    | 37                    | 0,6            | 0,3             | 28,8            | 9,8                    | 3,9                      | 48 000                        | 75 000                           | 28                          | 140  | 321  | 80                           | 410   | 966   | 42                           | 74,7 | 102,9 |
| 25                    | 37                    | 0,6            | 0,3             | 28,8            | 9,5                    | 3,6                      | 45 000                        | 70 000                           | 46                          | 139  | 278  | 137                          | 427   | 883   | 32,8                         | 50,5 | 67,9  |
| 25                    | 37                    | 0,6            | 0,3             | 29,3            | 5,7                    | 2,7                      | 53 000                        | 80 000                           | 21                          | 62   | 125  | 63                           | 198   | 413   | 19,8                         | 31,5 | 43,5  |
| 25                    | 37                    | 0,6            | 0,3             | 29,3            | 5,4                    | 2,6                      | 48 000                        | 75 000                           | 34                          | 101  | 202  | 97                           | 299   | 611   | 49,1                         | 73,6 | 96,4  |
| 25                    | 37                    | 0,6            | 0,3             | 29,3            | 5,4                    | 2,47                     | 60 000                        | 95 000                           | 23                          | 70   | 140  | 67                           | 204   | 415   | 48,8                         | 72,3 | 93,7  |
| 25                    | 37                    | 0,6            | 0,3             | 29,3            | 8,3                    | 2,47                     | 67 000                        | 100 000                          | 23                          | 70   | 140  | 67                           | 204   | 415   | 48,8                         | 72,3 | 93,7  |
| 26,5                  | 40,5                  | 1              | 1               | 31,7            | 17,2                   | 8                        | 32 000                        | 48 000                           | 75                          | 248  | 496  | 234                          | 851   | 1 828 | 28,1                         | 49,3 | 71,1  |
| 26,5                  | 40,5                  | 1              | 1               | 31,7            | 16,5                   | 7,7                      | 30 000                        | 45 000                           | 107                         | 398  | 848  | 313                          | 1 212 | 2 686 | 63,7                         | 106  | 146,2 |
| 26,5                  | 40,5                  | 1              | 1               | 31,7            | 17,2                   | 7,6                      | 40 000                        | 60 000                           | 36                          | 135  | 284  | 109                          | 432   | 967   | 23,3                         | 40,5 | 57,9  |
| 26,5                  | 40,5                  | 1              | 1               | 31,7            | 16,5                   | 7,3                      | 36 000                        | 53 000                           | 46                          | 205  | 460  | 131                          | 606   | 1 400 | 53                           | 91,6 | 114,9 |

# Spindle bearings

With large or small balls  
 Steel or ceramic balls  
 Steel or Cronidur rings  
 Open or sealed  
 Design DLR



**Dimension table** (continued) · Dimensions in mm

| Designation <sup>1)2)</sup> |                        |                        | Mass<br>m<br>≈ kg | Dimensions |    |    |     |                |                |                | Contact angle<br>α<br>° |                |
|-----------------------------|------------------------|------------------------|-------------------|------------|----|----|-----|----------------|----------------|----------------|-------------------------|----------------|
| Series 719                  | Series 70              | Series 72              |                   | d          | D  | B  | r   | r <sub>1</sub> | B <sub>N</sub> | S <sub>N</sub> |                         | S <sub>B</sub> |
| <b>B71905-C-T-P4S</b>       | –                      | –                      | 0,043             | <b>25</b>  | 42 | 9  | 0,3 | 0,3            | –              | –              | –                       | 15             |
| <b>B71905-E-T-P4S</b>       | –                      | –                      | 0,043             | <b>25</b>  | 42 | 9  | 0,3 | 0,3            | –              | –              | –                       | 25             |
| <b>HCB71905-C-T-P4S</b>     | –                      | –                      | 0,039             | <b>25</b>  | 42 | 9  | 0,3 | 0,3            | –              | –              | –                       | 15             |
| <b>HCB71905-E-T-P4S</b>     | –                      | –                      | 0,039             | <b>25</b>  | 42 | 9  | 0,3 | 0,3            | –              | –              | –                       | 25             |
| <b>RS71905-D-T-P4S</b>      | –                      | –                      | 0,045             | <b>25</b>  | 42 | 9  | 0,3 | 0,3            | –              | –              | –                       | 20             |
| <b>HS71905-C-T-P4S</b>      | –                      | –                      | 0,046             | <b>25</b>  | 42 | 9  | 0,3 | –              | –              | –              | –                       | 15             |
| <b>HS71905-E-T-P4S</b>      | –                      | –                      | 0,046             | <b>25</b>  | 42 | 9  | 0,3 | –              | –              | –              | –                       | 25             |
| <b>HC71905-E-T-P4S</b>      | –                      | –                      | 0,051             | <b>25</b>  | 42 | 9  | 0,3 | –              | –              | –              | –                       | 25             |
| <b>XC71905-E-T-P4S</b>      | –                      | –                      | 0,051             | <b>25</b>  | 42 | 9  | 0,3 | –              | –              | –              | –                       | 25             |
| –                           | <b>B7005-C-T-P4S</b>   | –                      | 0,071             | <b>25</b>  | 47 | 12 | 0,6 | 0,6            | –              | –              | –                       | 15             |
| –                           | <b>B7005-E-T-P4S</b>   | –                      | 0,07              | <b>25</b>  | 47 | 12 | 0,6 | 0,6            | –              | –              | –                       | 25             |
| –                           | <b>HCB7005-C-T-P4S</b> | –                      | 0,065             | <b>25</b>  | 47 | 12 | 0,6 | 0,6            | 2,2            | 6,6            | 1,4                     | 15             |
| –                           | <b>HCB7005-E-T-P4S</b> | –                      | 0,065             | <b>25</b>  | 47 | 12 | 0,6 | 0,6            | 2,2            | 6,6            | 1,4                     | 25             |
| –                           | <b>RS7005-D-T-P4S</b>  | –                      | 0,075             | <b>25</b>  | 47 | 12 | 0,6 | 0,6            | –              | –              | –                       | 20             |
| –                           | <b>HS7005-C-T-P4S</b>  | –                      | 0,088             | <b>25</b>  | 47 | 12 | 0,6 | –              | –              | –              | –                       | 15             |
| –                           | <b>HS7005-E-T-P4S</b>  | –                      | 0,088             | <b>25</b>  | 47 | 12 | 0,6 | –              | –              | –              | –                       | 25             |
| –                           | <b>HC7005-E-T-P4S</b>  | –                      | 0,092             | <b>25</b>  | 47 | 12 | 0,6 | –              | 2,2            | 6,6            | 1,4                     | 25             |
| –                           | <b>XC7005-E-T-P4S</b>  | –                      | 0,092             | <b>25</b>  | 47 | 12 | 0,6 | –              | 2,2            | 6,6            | 1,4                     | 25             |
| –                           | –                      | <b>B7205-C-T-P4S</b>   | 0,126             | <b>25</b>  | 52 | 15 | 1   | 1              | –              | –              | –                       | 15             |
| –                           | –                      | <b>B7205-E-T-P4S</b>   | 0,126             | <b>25</b>  | 52 | 15 | 1   | 1              | –              | –              | –                       | 25             |
| –                           | –                      | <b>HCB7205-C-T-P4S</b> | 0,113             | <b>25</b>  | 52 | 15 | 1   | 1              | –              | –              | –                       | 15             |
| –                           | –                      | <b>HCB7205-E-T-P4S</b> | 0,113             | <b>25</b>  | 52 | 15 | 1   | 1              | –              | –              | –                       | 25             |

<sup>1)</sup> Explanation of short designations, see page 130.

<sup>2)</sup> The bearings are also available with gap seals (type HSS, HCS, XCS or suffix 2RSD).

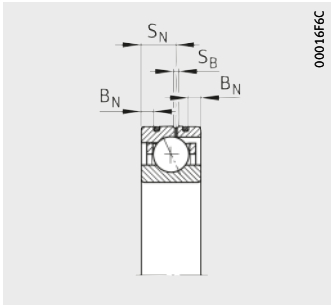
Ordering examples: B7005-C-2RSD-T-P4S-UL and HSS7005-E-T-P4S-UL.

<sup>3)</sup> The limiting speeds in the dimension tables are based on elastically preloaded single bearings.

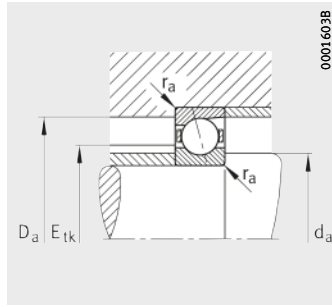
<sup>4)</sup> Explanation, see page 62.

<sup>5)</sup> Minimal quantity oil lubrication.

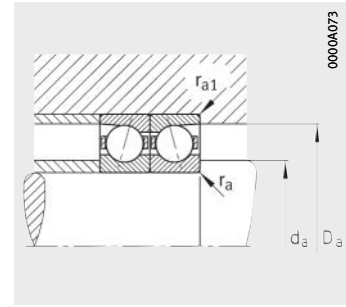
<sup>6)</sup> Ordering examples for Direct Lube design: HCB7005-EDLR-T-P4S-UL and HC7005-EDLR-T-P4S-UL.  
 DLR only up to bore code 22.



Design DLR<sup>6)</sup>



Mounting dimensions



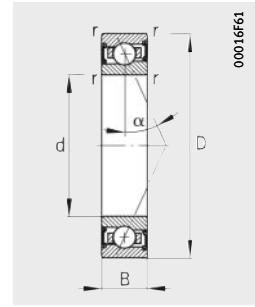
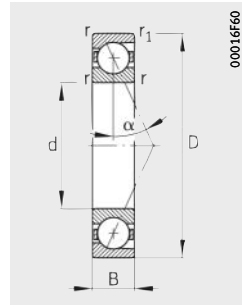
Mounting dimensions



| Mounting dimensions   |                       |                |                 |                 | Basic load ratings     |                          | Limiting speeds <sup>3)</sup> |                                  | Preload force <sup>4)</sup><br>F <sub>V</sub> |     |     | Lift-off force <sup>4)</sup><br>K <sub>aE</sub> |       |       | Axial rigidity <sup>4)</sup><br>c <sub>a</sub> |       |       |
|-----------------------|-----------------------|----------------|-----------------|-----------------|------------------------|--------------------------|-------------------------------|----------------------------------|---|-----|-----|---|-------|-------|--|-------|-------|
| d <sub>a</sub><br>h12 | D <sub>a</sub><br>H12 | r <sub>a</sub> | r <sub>a1</sub> | E <sub>tk</sub> | dyn.<br>C <sub>r</sub> | stat.<br>C <sub>0r</sub> | n <sub>G</sub> grease         | n <sub>G</sub> oil <sup>5)</sup> | L   | M   | H   | L   | M     | H     | L  | M     | H     |
|                       |                       | max.           |                 | nom.            | kN                     | kN                       | min <sup>-1</sup>             | min <sup>-1</sup>                | N   | N   | N   | N   | N     | N     | N/μm   | N/μm  | N/μm  |
| 29                    | 38,5                  | 0,3            | 0,3             | 31,8            | 8,3                    | 4,05                     | 36 000                        | 56 000                           | 33  | 124 | 258 | 102   | 418   | 934   | 24,9   | 45,4  | 66,3  |
| 29                    | 38,5                  | 0,3            | 0,3             | 31,8            | 7,9                    | 3,85                     | 32 000                        | 50 000                           | 40  | 188 | 426 | 115   | 566   | 1 335 | 54,1   | 97,3  | 136,8 |
| 29                    | 38,5                  | 0,3            | 0,3             | 31,8            | 8,3                    | 3,9                      | 50 000                        | 75 000                           | 13  | 63  | 142 | 39  | 199   | 475   | 19,4   | 36,6  | 53,4  |
| 29                    | 38,5                  | 0,3            | 0,3             | 31,8            | 7,9                    | 3,7                      | 45 000                        | 67 000                           | 21  | 105 | 243 | 60  | 310   | 735   | 48,7   | 87,4  | 120,9 |
| 29                    | 38,5                  | 0,3            | 0,3             | 31,8            | 7,4                    | 3,4                      | 43 000                        | 63 000                           | 36  | 109 | 218 | 107   | 333   | 689   | 36,5   | 56,1  | 75,2  |
| 29                    | 38,5                  | 0,3            | 0,3             | 32,2            | 3,9                    | 2,06                     | 48 000                        | 75 000                           | 14  | 43  | 85  | 43  | 135   | 282   | 17   | 26,8  | 36,9  |
| 29                    | 38,5                  | 0,3            | 0,3             | 32,2            | 3,65                   | 1,95                     | 43 000                        | 67 000                           | 23  | 69  | 138 | 66  | 204   | 416   | 42,2   | 63,1  | 82,4  |
| 29                    | 38,5                  | 0,3            | 0,3             | 32,2            | 3,65                   | 1,87                     | 56 000                        | 85 000                           | 16  | 47  | 95  | 45  | 138   | 281   | 41,8   | 61,9  | 80,1  |
| 29                    | 38,5                  | 0,3            | 0,3             | 32,2            | 5,6                    | 1,87                     | 63 000                        | 95 000                           | 16  | 47  | 95  | 45  | 138   | 281   | 41,8   | 61,9  | 80,1  |
| 30                    | 42                    | 0,6            | 0,3             | 33,5            | 14,3                   | 6,5                      | 34 000                        | 50 000                           | 74  | 249 | 507 | 226   | 831   | 1 807 | 29,6   | 51,2  | 73,54 |
| 30                    | 42                    | 0,6            | 0,3             | 33,5            | 13,6                   | 6,2                      | 30 000                        | 45 000                           | 100   | 383 | 823 | 290   | 1 150 | 2 560 | 67,2   | 111,5 | 152,7 |
| 30                    | 42                    | 0,6            | 0,3             | 33,5            | 14,3                   | 6,2                      | 45 000                        | 70 000                           | 35  | 133 | 285 | 104   | 419   | 944   | 24,6   | 42,5  | 60,2  |
| 30                    | 42                    | 0,6            | 0,3             | 33,5            | 13,6                   | 5,9                      | 40 000                        | 63 000                           | 41  | 196 | 446 | 117   | 573   | 1 338 | 55,4   | 96,9  | 132,8 |
| 30                    | 42                    | 0,6            | 0,3             | 33,5            | 13,6                   | 5,8                      | 38 000                        | 60 000                           | 65  | 195 | 390 | 192   | 597   | 1 234 | 42,5   | 65,4  | 87,7  |
| 30                    | 42                    | 0,6            | 0,3             | 34,3            | 5,8                    | 2,95                     | 45 000                        | 70 000                           | 21  | 63  | 127 | 64  | 201   | 419   | 20,6   | 32,7  | 45    |
| 30                    | 42                    | 0,6            | 0,3             | 34,3            | 5,5                    | 2,8                      | 40 000                        | 63 000                           | 35  | 104 | 207 | 100   | 306   | 626   | 51,2   | 76,7  | 100,4 |
| 30                    | 42                    | 0,6            | 0,3             | 34,3            | 5,5                    | 2,65                     | 53 000                        | 80 000                           | 23  | 70  | 140 | 67  | 204   | 415   | 50,4   | 74,7  | 96,7  |
| 30                    | 42                    | 0,6            | 0,3             | 34,3            | 8,4                    | 2,65                     | 56 000                        | 90 000                           | 23  | 70  | 140 | 67  | 204   | 415   | 50,4   | 74,7  | 96,7  |
| 31,5                  | 45,5                  | 1              | 1               | 36,5            | 18,3                   | 9,2                      | 28 000                        | 43 000                           | 80  | 265 | 531 | 248   | 906   | 1 949 | 30,4   | 53,4  | 77    |
| 31,5                  | 45,5                  | 1              | 1               | 36,5            | 17,5                   | 8,8                      | 26 000                        | 40 000                           | 114   | 425 | 907 | 333   | 1 293 | 2 868 | 69,2   | 115,2 | 158,8 |
| 31,5                  | 45,5                  | 1              | 1               | 36,5            | 18,3                   | 8,8                      | 36 000                        | 53 000                           | 39  | 145 | 306 | 117   | 465   | 1 042 | 25,3   | 44,1  | 63,1  |
| 31,5                  | 45,5                  | 1              | 1               | 36,5            | 17,5                   | 8,5                      | 32 000                        | 48 000                           | 49  | 220 | 495 | 140   | 650   | 1 504 | 57,6   | 99,8  | 125   |

# Spindle bearings

With large or small balls  
 Steel or ceramic balls  
 Steel or Cronidur rings  
 Open or sealed  
 Design DLR



**Dimension table** (continued) · Dimensions in mm

| Designation <sup>1)2)</sup> |                         |                        | Mass<br>m<br>≈ kg | Dimensions |    |    |     |                |                |                | Contact angle<br>α<br>° |                |
|-----------------------------|-------------------------|------------------------|-------------------|------------|----|----|-----|----------------|----------------|----------------|-------------------------|----------------|
| Series 719                  | Series 70               | Series 72              |                   | d          | D  | B  | r   | r <sub>1</sub> | B <sub>N</sub> | S <sub>N</sub> |                         | S <sub>B</sub> |
| <b>B71906-C-T-P4S</b>       | –                       | –                      | 0,05              | <b>30</b>  | 47 | 9  | 0,3 | 0,3            | –              | –              | –                       | 15             |
| <b>B71906-E-T-P4S</b>       | –                       | –                      | 0,05              | <b>30</b>  | 47 | 9  | 0,3 | 0,3            | –              | –              | –                       | 25             |
| <b>HCB71906-C-T-P4S</b>     | –                       | –                      | 0,045             | <b>30</b>  | 47 | 9  | 0,3 | 0,3            | 1,1            | 5,3            | 1,4                     | 15             |
| <b>HCB71906-E-T-P4S</b>     | –                       | –                      | 0,045             | <b>30</b>  | 47 | 9  | 0,3 | 0,3            | 1,1            | 5,3            | 1,4                     | 25             |
| <b>RS71906-D-T-P4S</b>      | –                       | –                      | 0,055             | <b>30</b>  | 47 | 9  | 0,3 | 0,3            | –              | –              | –                       | 20             |
| <b>HCRS71906-D-T-P4S</b>    | –                       | –                      | 0,045             | <b>30</b>  | 47 | 9  | 0,3 | 0,3            | 1,1            | 5,3            | 1,4                     | 20             |
| <b>HS71906-C-T-P4S</b>      | –                       | –                      | 0,05              | <b>30</b>  | 47 | 9  | 0,3 | –              | –              | –              | –                       | 15             |
| <b>HS71906-E-T-P4S</b>      | –                       | –                      | 0,05              | <b>30</b>  | 47 | 9  | 0,3 | –              | –              | –              | –                       | 25             |
| <b>HC71906-E-T-P4S</b>      | –                       | –                      | 0,054             | <b>30</b>  | 47 | 9  | 0,3 | –              | 1,1            | 5,3            | 1,4                     | 25             |
| <b>XC71906-E-T-P4S</b>      | –                       | –                      | 0,054             | <b>30</b>  | 47 | 9  | 0,3 | –              | 1,1            | 5,3            | 1,4                     | 25             |
| –                           | <b>B7006-C-T-P4S</b>    | –                      | 0,108             | <b>30</b>  | 55 | 13 | 1   | 1              | –              | –              | –                       | 15             |
| –                           | <b>B7006-E-T-P4S</b>    | –                      | 0,108             | <b>30</b>  | 55 | 13 | 1   | 1              | –              | –              | –                       | 25             |
| –                           | <b>HCB7006-C-T-P4S</b>  | –                      | 0,103             | <b>30</b>  | 55 | 13 | 1   | 1              | 2,8            | 7,2            | 1,4                     | 15             |
| –                           | <b>HCB7006-E-T-P4S</b>  | –                      | 0,102             | <b>30</b>  | 55 | 13 | 1   | 1              | 2,8            | 7,2            | 1,4                     | 25             |
| –                           | <b>RS7006-D-T-P4S</b>   | –                      | 0,115             | <b>30</b>  | 55 | 13 | 1   | 1              | –              | –              | –                       | 20             |
| –                           | <b>HCRS7006-D-T-P4S</b> | –                      | 0,115             | <b>30</b>  | 55 | 13 | 1   | 1              | 2,8            | 7,2            | 1,4                     | 20             |
| –                           | <b>HS7006-C-T-P4S</b>   | –                      | 0,124             | <b>30</b>  | 55 | 13 | 1   | –              | –              | –              | –                       | 15             |
| –                           | <b>HS7006-E-T-P4S</b>   | –                      | 0,124             | <b>30</b>  | 55 | 13 | 1   | –              | –              | –              | –                       | 25             |
| –                           | <b>HC7006-E-T-P4S</b>   | –                      | 0,133             | <b>30</b>  | 55 | 13 | 1   | –              | 2,8            | 7,2            | 1,4                     | 25             |
| –                           | <b>XC7006-E-T-P4S</b>   | –                      | 0,133             | <b>30</b>  | 55 | 13 | 1   | –              | 2,8            | 7,2            | 1,4                     | 25             |
| –                           | –                       | <b>B7206-C-T-P4S</b>   | 0,202             | <b>30</b>  | 62 | 16 | 1   | 1              | –              | –              | –                       | 15             |
| –                           | –                       | <b>B7206-E-T-P4S</b>   | 0,201             | <b>30</b>  | 62 | 16 | 1   | 1              | –              | –              | –                       | 25             |
| –                           | –                       | <b>HCB7206-C-T-P4S</b> | 0,171             | <b>30</b>  | 62 | 16 | 1   | 1              | –              | –              | –                       | 15             |
| –                           | –                       | <b>HCB7206-E-T-P4S</b> | 0,171             | <b>30</b>  | 62 | 16 | 1   | 1              | –              | –              | –                       | 25             |

<sup>1)</sup> Explanation of short designations, see page 130.

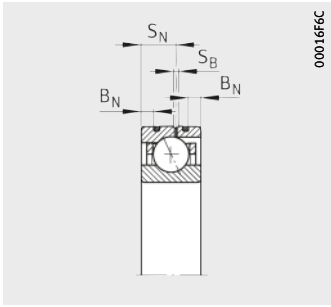
<sup>2)</sup> The bearings are also available with gap seals (type HSS, HCS, XCS or suffix 2RSD).  
 Ordering examples: B7006-C-2RSD-T-P4S-UL and HSS7006-E-T-P4S-UL.

<sup>3)</sup> The limiting speeds in the dimension tables are based on elastically preloaded single bearings.

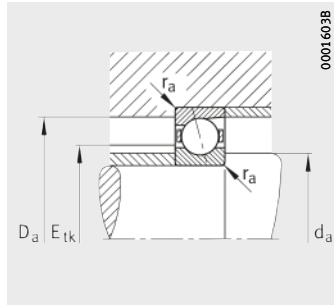
<sup>4)</sup> Explanation, see page 62.

<sup>5)</sup> Minimal quantity oil lubrication.

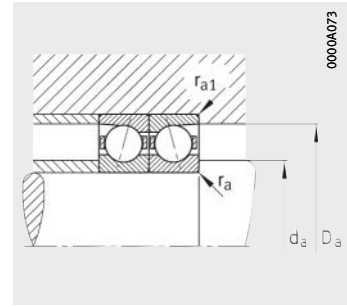
<sup>6)</sup> Ordering examples for Direct Lube design: HCB7006-EDLR-T-P4S-UL and HC7006-EDLR-T-P4S-UL.  
 DLR only up to bore code 22.



Design DLR<sup>6)</sup>



Mounting dimensions



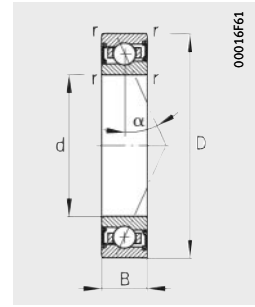
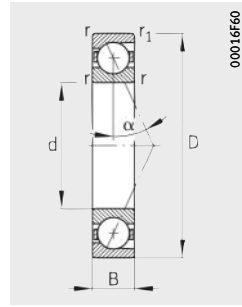
Mounting dimensions



| Mounting dimensions   |                       |                |                 |                 | Basic load ratings     |                          | Limiting speeds <sup>3)</sup> |                                  | Preload force <sup>4)</sup><br>F <sub>V</sub> |     |       | Lift-off force <sup>4)</sup><br>K <sub>aE</sub> |       |       | Axial rigidity <sup>4)</sup><br>c <sub>a</sub> |       |       |
|-----------------------|-----------------------|----------------|-----------------|-----------------|------------------------|--------------------------|-------------------------------|----------------------------------|---|-----|-------|---|-------|-------|--|-------|-------|
| d <sub>a</sub><br>h12 | D <sub>a</sub><br>H12 | r <sub>a</sub> | r <sub>a1</sub> | E <sub>tk</sub> | dyn.<br>C <sub>r</sub> | stat.<br>C <sub>0r</sub> | n <sub>G</sub> grease         | n <sub>G</sub> oil <sup>5)</sup> | L   | M   | H     | L   | M     | H     | L  | M     | H     |
|                       |                       | max.           | nom.            |                 | kN                     | kN                       | min <sup>-1</sup>             | min <sup>-1</sup>                | N   | N   | N     | N   | N     | N     | N/μm   | N/μm  | N/μm  |
| 34                    | 43,5                  | 0,3            | 0,3             | 36,8            | 8,8                    | 4,65                     | 30 000                        | 48 000                           | 34  | 131 | 274   | 106   | 439   | 985   | 27   | 49,3  | 72,1  |
| 34                    | 43,5                  | 0,3            | 0,3             | 36,8            | 8,4                    | 4,4                      | 28 000                        | 43 000                           | 39  | 193 | 441   | 114   | 580   | 1 377 | 58   | 105,2 | 147,9 |
| 34                    | 43,5                  | 0,3            | 0,3             | 36,8            | 8,8                    | 4,45                     | 43 000                        | 67 000                           | 14  | 67  | 151   | 40  | 210   | 504   | 21,1   | 40    | 58,3  |
| 34                    | 43,5                  | 0,3            | 0,3             | 36,8            | 8,4                    | 4,25                     | 38 000                        | 60 000                           | 21  | 109 | 254   | 60  | 322   | 768   | 52,5   | 95,1  | 131,7 |
| 34                    | 43,5                  | 0,3            | 0,3             | 36,8            | 7,9                    | 3,9                      | 36 000                        | 56 000                           | 39  | 116 | 232   | 114   | 353   | 730   | 40,1   | 61,4  | 82,2  |
| 34                    | 43,5                  | 0,3            | 0,3             | 36,8            | 7,9                    | 3,7                      | 45 000                        | 70 000                           | 27  | 80  | 160   | 77  | 238   | 489   | 39,4   | 59,4  | 65,8  |
| 34                    | 43,5                  | 0,3            | 0,3             | 36,75           | 5,9                    | 3,1                      | 43 000                        | 63 000                           | 21  | 64  | 129   | 65  | 204   | 425   | 21,3   | 33,8  | 46,5  |
| 34                    | 43,5                  | 0,3            | 0,3             | 36,75           | 5,6                    | 2,95                     | 38 000                        | 60 000                           | 35  | 104 | 207   | 100   | 306   | 625   | 52,9   | 79,1  | 103,4 |
| 34                    | 43,5                  | 0,3            | 0,3             | 36,75           | 5,6                    | 2,85                     | 48 000                        | 75 000                           | 24  | 72  | 143   | 69  | 209   | 425   | 52,5   | 77,7  | 100,6 |
| 34                    | 43,5                  | 0,3            | 0,3             | 36,75           | 8,5                    | 2,85                     | 53 000                        | 85 000                           | 24  | 72  | 143   | 69  | 209   | 425   | 52,5   | 77,7  | 100,6 |
| 36                    | 49                    | 1              | 0,3             | 40,4            | 15,4                   | 7,3                      | 28 000                        | 43 000                           | 74  | 252 | 511   | 228   | 848   | 1 844 | 32,4   | 56,7  | 81,79 |
| 36                    | 49                    | 1              | 0,3             | 40,4            | 14,6                   | 7                        | 24 000                        | 38 000                           | 101   | 394 | 850   | 294   | 1 188 | 2 661 | 73,5   | 123,2 | 169,7 |
| 36                    | 49                    | 1              | 0,3             | 40,4            | 15,4                   | 7                        | 38 000                        | 60 000                           | 35  | 136 | 291   | 104   | 431   | 976   | 26,9   | 47    | 67,1  |
| 36                    | 49                    | 1              | 0,3             | 40,4            | 14,6                   | 6,7                      | 34 000                        | 53 000                           | 41  | 201 | 463   | 117   | 592   | 1 395 | 60,1   | 106,9 | 147,3 |
| 36                    | 49                    | 1              | 0,3             | 40,4            | 14,3                   | 6,5                      | 32 000                        | 50 000                           | 68  | 205 | 410   | 201   | 625   | 1 293 | 45,3   | 69,6  | 93,4  |
| 36                    | 49                    | 1              | 0,3             | 40,4            | 14,3                   | 6,3                      | 40 000                        | 63 000                           | 46  | 139 | 278   | 135   | 416   | 855   | 44,4   | 66,9  | 88,4  |
| 36                    | 49                    | 1              | 0,3             | 40,5            | 8,2                    | 4,25                     | 38 000                        | 56 000                           | 29  | 88  | 177   | 89  | 280   | 584   | 24,4   | 38,7  | 53,2  |
| 36                    | 49                    | 1              | 0,3             | 40,5            | 7,8                    | 4,05                     | 34 000                        | 53 000                           | 48  | 143 | 286   | 138   | 423   | 865   | 60,6   | 90,6  | 118,6 |
| 36                    | 49                    | 1              | 0,3             | 40,5            | 7,8                    | 3,85                     | 43 000                        | 67 000                           | 33  | 98  | 197   | 94  | 287   | 583   | 60   | 88,8  | 115   |
| 36                    | 49                    | 1              | 0,3             | 40,5            | 12                     | 3,85                     | 48 000                        | 75 000                           | 33  | 98  | 197   | 94  | 287   | 583   | 60   | 88,8  | 115   |
| 37,5                  | 54,5                  | 1              | 1               | 43,7            | 28,5                   | 14,7                     | 24 000                        | 38 000                           | 123   | 404 | 806   | 385   | 1 375 | 2 945 | 39,6   | 68,8  | 98,9  |
| 37,5                  | 54,5                  | 1              | 1               | 43,7            | 27                     | 14,1                     | 22 000                        | 36 000                           | 177   | 641 | 1 355 | 518   | 1 946 | 4 271 | 90,4   | 148,3 | 203,3 |
| 37,5                  | 54,5                  | 1              | 1               | 43,7            | 28,5                   | 14,1                     | 30 000                        | 45 000                           | 62  | 222 | 465   | 185   | 711   | 1 576 | 33,3   | 57,1  | 81,1  |
| 37,5                  | 54,5                  | 1              | 1               | 43,7            | 27                     | 13,5                     | 26 000                        | 40 000                           | 80  | 339 | 749   | 231   | 1 001 | 2 273 | 76,8   | 129,7 | 163,6 |

# Spindle bearings

With large or small balls  
 Steel or ceramic balls  
 Steel or Cronidur rings  
 Open or sealed  
 Design DLR



**Dimension table** (continued) · Dimensions in mm

| Designation <sup>1)2)</sup> |                         |                        | Mass<br>m<br>≈ kg | Dimensions |    |    |     |                |                |                | Contact angle<br>α<br>° |                |
|-----------------------------|-------------------------|------------------------|-------------------|------------|----|----|-----|----------------|----------------|----------------|-------------------------|----------------|
| Series 719                  | Series 70               | Series 72              |                   | d          | D  | B  | r   | r <sub>1</sub> | B <sub>N</sub> | S <sub>N</sub> |                         | S <sub>B</sub> |
|                             |                         |                        |                   |            |    |    |     | min.           |                |                |                         |                |
| <b>B71907-C-T-P4S</b>       | –                       | –                      | 0,077             | <b>35</b>  | 55 | 10 | 0,6 | 0,6            | –              | –              | –                       | 15             |
| <b>B71907-E-T-P4S</b>       | –                       | –                      | 0,077             | <b>35</b>  | 55 | 10 | 0,6 | 0,6            | –              | –              | –                       | 25             |
| <b>HCB71907-C-T-P4S</b>     | –                       | –                      | 0,067             | <b>35</b>  | 55 | 10 | 0,6 | 0,6            | 1,6            | 5,8            | 1,4                     | 15             |
| <b>HCB71907-E-T-P4S</b>     | –                       | –                      | 0,067             | <b>35</b>  | 55 | 10 | 0,6 | 0,6            | 1,6            | 5,8            | 1,4                     | 25             |
| <b>RS71907-D-T-P4S</b>      | –                       | –                      | 0,08              | <b>35</b>  | 55 | 10 | 0,6 | 0,6            | –              | –              | –                       | 20             |
| <b>HCRS71907-D-T-P4S</b>    | –                       | –                      | 0,068             | <b>35</b>  | 55 | 10 | 0,6 | 0,6            | 1,6            | 5,8            | 1,4                     | 20             |
| <b>HS71907-C-T-P4S</b>      | –                       | –                      | 0,081             | <b>35</b>  | 55 | 10 | 0,6 | –              | –              | –              | –                       | 15             |
| <b>HS71907-E-T-P4S</b>      | –                       | –                      | 0,081             | <b>35</b>  | 55 | 10 | 0,6 | –              | –              | –              | –                       | 25             |
| <b>HC71907-E-T-P4S</b>      | –                       | –                      | 0,086             | <b>35</b>  | 55 | 10 | 0,6 | –              | 1,6            | 5,8            | 1,4                     | 25             |
| <b>XC71907-E-T-P4S</b>      | –                       | –                      | 0,086             | <b>35</b>  | 55 | 10 | 0,6 | –              | –              | –              | –                       | 25             |
| –                           | <b>B7007-C-T-P4S</b>    | –                      | 0,153             | <b>35</b>  | 62 | 14 | 1   | 1              | –              | –              | –                       | 15             |
| –                           | <b>B7007-E-T-P4S</b>    | –                      | 0,152             | <b>35</b>  | 62 | 14 | 1   | 1              | –              | –              | –                       | 25             |
| –                           | <b>HCB7007-C-T-P4S</b>  | –                      | 0,135             | <b>35</b>  | 62 | 14 | 1   | 1              | 2,8            | 8              | 1,4                     | 15             |
| –                           | <b>HCB7007-E-T-P4S</b>  | –                      | 0,135             | <b>35</b>  | 62 | 14 | 1   | 1              | 2,8            | 8              | 1,4                     | 25             |
| –                           | <b>RS7007-D-T-P4S</b>   | –                      | 0,155             | <b>35</b>  | 62 | 14 | 1   | 1              | –              | –              | –                       | 20             |
| –                           | <b>HCRS7007-D-T-P4S</b> | –                      | 0,155             | <b>35</b>  | 62 | 14 | 1   | 1              | 2,8            | 8              | 1,4                     | 20             |
| –                           | <b>HS7007-C-T-P4S</b>   | –                      | 0,169             | <b>35</b>  | 62 | 14 | 1   | –              | –              | –              | –                       | 15             |
| –                           | <b>HS7007-E-T-P4S</b>   | –                      | 0,169             | <b>35</b>  | 62 | 14 | 1   | –              | –              | –              | –                       | 25             |
| –                           | <b>HC7007-E-T-P4S</b>   | –                      | 0,178             | <b>35</b>  | 62 | 14 | 1   | –              | 2,8            | 8              | 1,4                     | 25             |
| –                           | <b>XC7007-E-T-P4S</b>   | –                      | 0,178             | <b>35</b>  | 62 | 14 | 1   | –              | 2,8            | 8              | 1,4                     | 25             |
| –                           | –                       | <b>B7207-C-T-P4S</b>   | 0,301             | <b>35</b>  | 72 | 17 | 1,1 | 1,1            | –              | –              | –                       | 15             |
| –                           | –                       | <b>B7207-E-T-P4S</b>   | 0,3               | <b>35</b>  | 72 | 17 | 1,1 | 1,1            | –              | –              | –                       | 25             |
| –                           | –                       | <b>HCB7207-C-T-P4S</b> | 0,265             | <b>35</b>  | 72 | 17 | 1,1 | 1,1            | –              | –              | –                       | 15             |
| –                           | –                       | <b>HCB7207-E-T-P4S</b> | 0,264             | <b>35</b>  | 72 | 17 | 1,1 | 1,1            | –              | –              | –                       | 25             |

<sup>1)</sup> Explanation of short designations, see page 130.

<sup>2)</sup> The bearings are also available with gap seals (type HSS, HCS, XCS or suffix 2RSD).  
 Ordering examples: B7007-C-2RSD-T-P4S-UL and HSS7007-E-T-P4S-UL.

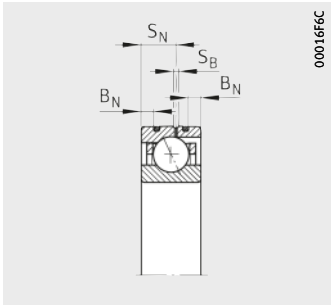
<sup>3)</sup> The limiting speeds in the dimension tables are based on elastically preloaded single bearings.

<sup>4)</sup> Explanation, see page 62.

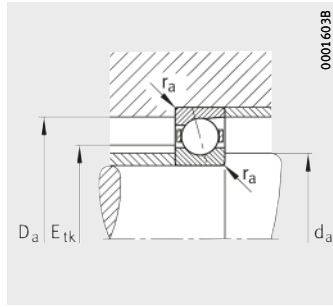
<sup>5)</sup> Minimal quantity oil lubrication.

<sup>6)</sup> Ordering examples for Direct Lube design: HCB7007-EDLR-T-P4S-UL and HC7007-EDLR-T-P4S-UL.  
 DLR only up to bore code 22.

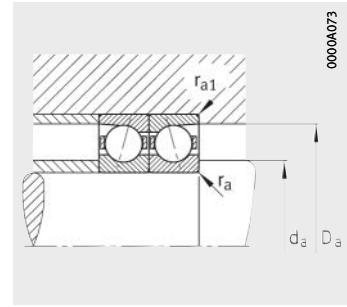




Design DLR<sup>6)</sup>



Mounting dimensions



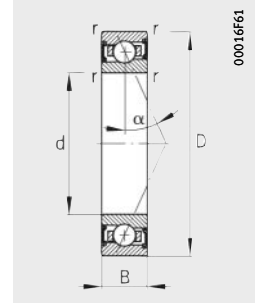
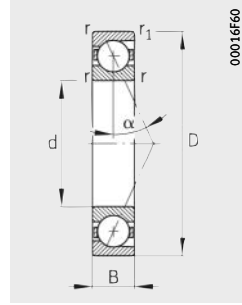
Mounting dimensions



| Mounting dimensions   |                       |                        |                         |                         | Basic load ratings           |                                | Limiting speeds <sup>3)</sup>              |   | Preload force <sup>4)</sup><br>F <sub>V</sub> |        |        | Lift-off force <sup>4)</sup><br>K <sub>aE</sub> |        |        | Axial rigidity <sup>4)</sup><br>C <sub>a</sub> |           |           |
|-----------------------|-----------------------|------------------------|-------------------------|-------------------------|------------------------------|--------------------------------|--|---|---|--------|--------|---|--------|--------|--|-----------|-----------|
| d <sub>a</sub><br>h12 | D <sub>a</sub><br>H12 | r <sub>a</sub><br>max. | r <sub>a1</sub><br>nom. | E <sub>tk</sub><br>nom. | dyn.<br>C <sub>r</sub><br>kN | stat.<br>C <sub>0r</sub><br>kN | n <sub>G</sub> grease<br>min <sup>-1</sup> | n <sub>G</sub> oil <sup>5)</sup><br>min <sup>-1</sup> | L<br>N  | M<br>N | H<br>N | L<br>N  | M<br>N | H<br>N | L<br>N/μm                                      | M<br>N/μm | H<br>N/μm |
| 40                    | 51,5                  | 0,6                    | 0,6                     | 44                      | 12,1                         | 6,8                            | 26 000                                     | 40 000  | 50  | 185    | 384    | 155   | 619    | 1 377  | 33,5   | 60,2      | 87,5      |
| 40                    | 51,5                  | 0,6                    | 0,6                     | 44                      | 11,5                         | 6,5                            | 24 000                                     | 36 000  | 60  | 273    | 613    | 174   | 820    | 1 910  | 72,9   | 128,5     | 179,3     |
| 40                    | 51,5                  | 0,6                    | 0,6                     | 44                      | 12,1                         | 6,5                            | 36 000                                     | 56 000  | 21  | 96     | 213    | 63  | 301    | 709    | 26,7   | 49,1      | 71        |
| 40                    | 51,5                  | 0,6                    | 0,6                     | 44                      | 11,5                         | 6,2                            | 32 000                                     | 50 000  | 33  | 158    | 359    | 95  | 463    | 1 081  | 66,7   | 117       | 160,7     |
| 40                    | 51,5                  | 0,6                    | 0,6                     | 44                      | 11,3                         | 6,1                            | 30 000                                     | 48 000  | 52  | 156    | 311    | 153   | 474    | 980    | 49   | 75,2      | 100,7     |
| 40                    | 51,5                  | 0,6                    | 0,6                     | 44                      | 11,3                         | 5,8                            | 38 000                                     | 60 000  | 36  | 109    | 218    | 106   | 326    | 670    | 48,5   | 73,2      | 82,7      |
| 40                    | 51,5                  | 0,6                    | 0,6                     | 43,3                    | 6,4                          | 3,8                            | 36 000                                     | 56 000  | 23  | 70     | 140    | 70  | 220    | 459    | 24,5   | 38,6      | 53        |
| 40                    | 51,5                  | 0,6                    | 0,6                     | 43,3                    | 6,1                          | 3,6                            | 32 000                                     | 50 000  | 38  | 113    | 226    | 109   | 333    | 680    | 61   | 91,1      | 119       |
| 40                    | 51,5                  | 0,6                    | 0,6                     | 43,3                    | 6,1                          | 3,45                           | 40 000                                     | 63 000  | 26  | 78     | 155    | 74  | 226    | 459    | 60,5   | 89,4      | 115,6     |
| 40                    | 51,5                  | 0,6                    | 0,6                     | 43,3                    | 9,3                          | 3,45                           | 45 000                                     | 70 000  | 26  | 78     | 155    | 74  | 226    | 459    | 60,5   | 89,4      | 115,6     |
| 41                    | 56                    | 1                      | 0,3                     | 45,6                    | 19                           | 9,6                            | 24 000                                     | 38 000  | 96  | 324    | 656    | 296   | 1 087  | 2 357  | 38,3   | 66,6      | 95,76     |
| 41                    | 56                    | 1                      | 0,3                     | 45,6                    | 18,1                         | 9,2                            | 22 000                                     | 34 000  | 135   | 514    | 1 102  | 394   | 1 551  | 3 446  | 87,9   | 145,9     | 200,3     |
| 41                    | 56                    | 1                      | 0,3                     | 45,6                    | 19                           | 9,2                            | 34 000                                     | 53 000  | 47  | 176    | 375    | 138   | 558    | 1 255  | 32   | 55,5      | 78,9      |
| 41                    | 56                    | 1                      | 0,3                     | 45,6                    | 18,1                         | 8,8                            | 30 000                                     | 45 000  | 55  | 259    | 588    | 157   | 761    | 1 771  | 72,1   | 125,9     | 172,6     |
| 41                    | 56                    | 1                      | 0,3                     | 45,6                    | 18,1                         | 8,7                            | 28 000                                     | 43 000  | 85  | 254    | 508    | 249   | 776    | 1 605  | 53,8   | 82,7      | 111       |
| 41                    | 56                    | 1                      | 0,3                     | 45,6                    | 18,1                         | 8,7                            | 36 000                                     | 56 000  | 59  | 176    | 352    | 171   | 527    | 1 083  | 53   | 80,1      | 105,8     |
| 41                    | 56                    | 1                      | 0,3                     | 46,5                    | 8,9                          | 5                              | 34 000                                     | 50 000  | 31  | 93     | 187    | 94  | 295    | 614    | 27,1   | 42,8      | 58,8      |
| 41                    | 56                    | 1                      | 0,3                     | 46,5                    | 8,4                          | 4,7                            | 30 000                                     | 45 000  | 51  | 152    | 304    | 146   | 448    | 915    | 67,7   | 101,1     | 132,1     |
| 41                    | 56                    | 1                      | 0,3                     | 46,5                    | 8,4                          | 4,5                            | 38 000                                     | 60 000  | 35  | 105    | 210    | 101   | 307    | 623    | 67,3   | 99,5      | 128,7     |
| 41                    | 56                    | 1                      | 0,3                     | 46,5                    | 12,8                         | 4,5                            | 43 000                                     | 67 000  | 35  | 105    | 210    | 101   | 307    | 623    | 67,3   | 99,5      | 128,7     |
| 44                    | 63                    | 1                      | 1                       | 50,7                    | 31,5                         | 17,9                           | 20 000                                     | 34 000  | 134   | 443    | 887    | 418   | 1 500  | 3 223  | 44,8   | 77,8      | 111,8     |
| 44                    | 63                    | 1                      | 1                       | 50,7                    | 30                           | 17,1                           | 19 000                                     | 32 000  | 195   | 710    | 1 504  | 570   | 2 152  | 4 730  | 103,2  | 169,4     | 232,2     |
| 44                    | 63                    | 1                      | 1                       | 50,7                    | 31,5                         | 17,2                           | 26 000                                     | 40 000  | 67  | 243    | 510    | 200   | 774    | 1 720  | 37,7   | 64,7      | 91,8      |
| 44                    | 63                    | 1                      | 1                       | 50,7                    | 30                           | 16,4                           | 22 000                                     | 36 000  | 84  | 363    | 806    | 242   | 1 069  | 2 438  | 86,2   | 146,4     | 184,1     |

# Spindle bearings

With large or small balls  
 Steel or ceramic balls  
 Steel or Cronidur rings  
 Open or sealed  
 Design DLR



**Dimension table** (continued) · Dimensions in mm

| Designation <sup>1)2)</sup> |                         |                        | Mass<br>m<br>≈ kg | Dimensions |    |    |     |                |                |                |                | Contact angle<br>α<br>° |
|-----------------------------|-------------------------|------------------------|-------------------|------------|----|----|-----|----------------|----------------|----------------|----------------|-------------------------|
| Series 719                  | Series 70               | Series 72              |                   | d          | D  | B  | r   | r <sub>1</sub> | B <sub>N</sub> | S <sub>N</sub> | S <sub>B</sub> |                         |
| <b>B71908-C-T-P4S</b>       | –                       | –                      | 0,1               | <b>40</b>  | 62 | 12 | 0,6 | 0,6            | –              | –              | –              | 15                      |
| <b>B71908-E-T-P4S</b>       | –                       | –                      | 0,099             | <b>40</b>  | 62 | 12 | 0,6 | 0,6            | –              | –              | –              | 25                      |
| <b>HCB71908-C-T-P4S</b>     | –                       | –                      | 0,092             | <b>40</b>  | 62 | 12 | 0,6 | 0,6            | 2,2            | 6,6            | 1,4            | 15                      |
| <b>HCB71908-E-T-P4S</b>     | –                       | –                      | 0,092             | <b>40</b>  | 62 | 12 | 0,6 | 0,6            | 2,2            | 6,6            | 1,4            | 25                      |
| <b>RS71908-D-T-P4S</b>      | –                       | –                      | 0,105             | <b>40</b>  | 62 | 12 | 0,6 | 0,6            | –              | –              | –              | 20                      |
| <b>HCRS71908-D-T-P4S</b>    | –                       | –                      | 0,09              | <b>40</b>  | 62 | 12 | 0,6 | 0,6            | 2,2            | 6,6            | 1,4            | 20                      |
| <b>HS71908-C-T-P4S</b>      | –                       | –                      | 0,125             | <b>40</b>  | 62 | 12 | 0,6 | –              | –              | –              | –              | 15                      |
| <b>HS71908-E-T-P4S</b>      | –                       | –                      | 0,125             | <b>40</b>  | 62 | 12 | 0,6 | –              | –              | –              | –              | 25                      |
| <b>HC71908-E-T-P4S</b>      | –                       | –                      | 0,129             | <b>40</b>  | 62 | 12 | 0,6 | –              | 2,2            | 6,6            | 1,4            | 25                      |
| <b>XC71908-E-T-P4S</b>      | –                       | –                      | 0,129             | <b>40</b>  | 62 | 12 | 0,6 | –              | 2,2            | 6,6            | 1,4            | 25                      |
| –                           | <b>B7008-C-T-P4S</b>    | –                      | 0,188             | <b>40</b>  | 68 | 15 | 1   | 1              | –              | –              | –              | 15                      |
| –                           | <b>B7008-E-T-P4S</b>    | –                      | 0,188             | <b>40</b>  | 68 | 15 | 1   | 1              | –              | –              | –              | 25                      |
| –                           | <b>HCB7008-C-T-P4S</b>  | –                      | 0,168             | <b>40</b>  | 68 | 15 | 1   | 1              | 2,8            | 8,5            | 1,4            | 15                      |
| –                           | <b>HCB7008-E-T-P4S</b>  | –                      | 0,168             | <b>40</b>  | 68 | 15 | 1   | 1              | 2,8            | 8,5            | 1,4            | 25                      |
| –                           | <b>RS7008-D-T-P4S</b>   | –                      | 0,19              | <b>40</b>  | 68 | 15 | 1   | 1              | –              | –              | –              | 20                      |
| –                           | <b>HCRS7008-D-T-P4S</b> | –                      | 0,19              | <b>40</b>  | 68 | 15 | 1   | 1              | 2,8            | 8,5            | 1,4            | 20                      |
| –                           | <b>HS7008-C-T-P4S</b>   | –                      | 0,211             | <b>40</b>  | 68 | 15 | 1   | –              | –              | –              | –              | 15                      |
| –                           | <b>HS7008-E-T-P4S</b>   | –                      | 0,211             | <b>40</b>  | 68 | 15 | 1   | –              | –              | –              | –              | 25                      |
| –                           | <b>HC7008-E-T-P4S</b>   | –                      | 0,221             | <b>40</b>  | 68 | 15 | 1   | –              | 2,8            | 8,5            | 1,4            | 25                      |
| –                           | <b>XC7008-E-T-P4S</b>   | –                      | 0,221             | <b>40</b>  | 68 | 15 | 1   | –              | 2,8            | 8,5            | 1,4            | 25                      |
| –                           | –                       | <b>B7208-C-T-P4S</b>   | 0,372             | <b>40</b>  | 80 | 18 | 1,1 | 1,1            | –              | –              | –              | 15                      |
| –                           | –                       | <b>B7208-E-T-P4S</b>   | 0,371             | <b>40</b>  | 80 | 18 | 1,1 | 1,1            | –              | –              | –              | 25                      |
| –                           | –                       | <b>HCB7208-C-T-P4S</b> | 0,322             | <b>40</b>  | 80 | 18 | 1,1 | 1,1            | –              | –              | –              | 15                      |
| –                           | –                       | <b>HCB7208-E-T-P4S</b> | 0,321             | <b>40</b>  | 80 | 18 | 1,1 | 1,1            | –              | –              | –              | 25                      |

<sup>1)</sup> Explanation of short designations, see page 130.

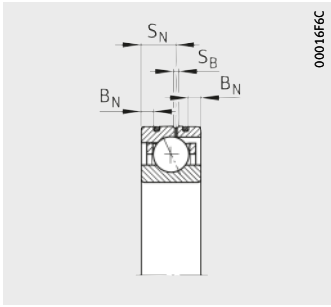
<sup>2)</sup> The bearings are also available with gap seals (type HSS, HCS, XCS or suffix 2RSD).  
 Ordering examples: B7008-C-2RSD-T-P4S-UL and HSS7008-E-T-P4S-UL.

<sup>3)</sup> The limiting speeds in the dimension tables are based on elastically preloaded single bearings.

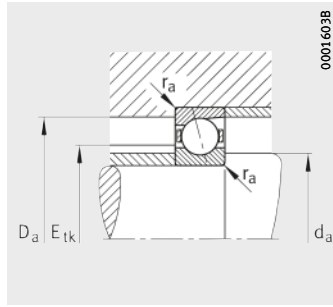
<sup>4)</sup> Explanation, see page 62.

<sup>5)</sup> Minimal quantity oil lubrication.

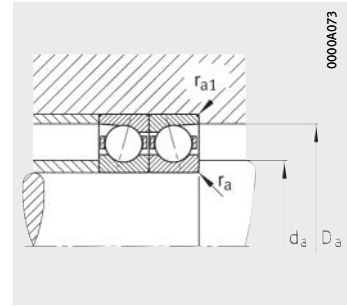
<sup>6)</sup> Ordering examples for Direct Lube design: HCB7008-EDLR-T-P4S-UL and HC7008-EDLR-T-P4S-UL.  
 DLR only up to bore code 22.



Design DLR<sup>6)</sup>



Mounting dimensions



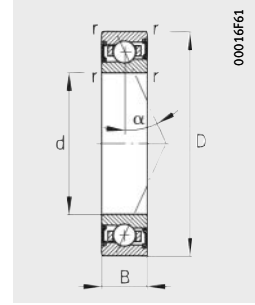
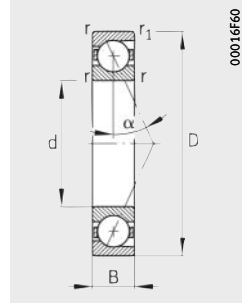
Mounting dimensions



| Mounting dimensions   |                       |                |                 |                 | Basic load ratings     |                          | Limiting speeds <sup>3)</sup> |                                  | Preload force <sup>4)</sup><br>F <sub>v</sub> |     |       | Lift-off force <sup>4)</sup><br>K <sub>aE</sub> |       |       | Axial rigidity <sup>4)</sup><br>c <sub>a</sub> |       |       |
|-----------------------|-----------------------|----------------|-----------------|-----------------|------------------------|--------------------------|-------------------------------|----------------------------------|---|-----|-------|---|-------|-------|--|-------|-------|
| d <sub>a</sub><br>h12 | D <sub>a</sub><br>H12 | r <sub>a</sub> | r <sub>a1</sub> | E <sub>tk</sub> | dyn.<br>C <sub>r</sub> | stat.<br>C <sub>0r</sub> | n <sub>G</sub> grease         | n <sub>G</sub> oil <sup>5)</sup> | L   | M   | H     | L   | M     | H     | L  | M     | H     |
|                       |                       | max.           |                 | nom.            | kN                     | kN                       | min <sup>-1</sup>             | min <sup>-1</sup>                | N   | N   | N     | N   | N     | N     | N/μm   | N/μm  | N/μm  |
| 45                    | 58,5                  | 0,6            | 0,6             | 49,1            | 18                     | 9,9                      | 24 000                        | 36 000                           | 84  | 292 | 594   | 259   | 979   | 2 140 | 40,7   | 71,6  | 103,4 |
| 45                    | 58,5                  | 0,6            | 0,6             | 49,1            | 17,1                   | 9,4                      | 20 000                        | 32 000                           | 111   | 447 | 974   | 324   | 1 348 | 3 043 | 91,3   | 154,5 | 213,4 |
| 45                    | 58,5                  | 0,6            | 0,6             | 49,1            | 18                     | 9,4                      | 32 000                        | 50 000                           | 39  | 156 | 337   | 116   | 494   | 1 127 | 33,5   | 59,2  | 84,7  |
| 45                    | 58,5                  | 0,6            | 0,6             | 49,1            | 17,1                   | 9                        | 28 000                        | 45 000                           | 41  | 220 | 514   | 117   | 645   | 1 548 | 72,4   | 132,2 | 183,2 |
| 45                    | 58,5                  | 0,6            | 0,6             | 49,1            | 16,7                   | 8,7                      | 26 000                        | 40 000                           | 79  | 236 | 472   | 232   | 720   | 1 489 | 57,2   | 87,7  | 117,6 |
| 45                    | 58,5                  | 0,6            | 0,6             | 49,1            | 16,7                   | 8,4                      | 34 000                        | 53 000                           | 54  | 161 | 322   | 156   | 481   | 988   | 56   | 84,4  | 98,9  |
| 45                    | 58,5                  | 0,6            | 0,6             | 49,3            | 6,8                    | 4,3                      | 32 000                        | 48 000                           | 24  | 72  | 145   | 72  | 227   | 473   | 26,6   | 41,8  | 57,2  |
| 45                    | 58,5                  | 0,6            | 0,6             | 49,3            | 6,4                    | 4,05                     | 28 000                        | 43 000                           | 39  | 117 | 235   | 113   | 345   | 704   | 66,6   | 99,2  | 129,3 |
| 45                    | 58,5                  | 0,6            | 0,6             | 49,3            | 6,4                    | 3,9                      | 36 000                        | 56 000                           | 27  | 82  | 164   | 78  | 238   | 484   | 66,4   | 98    | 126,6 |
| 45                    | 58,5                  | 0,6            | 0,6             | 49,3            | 9,7                    | 3,9                      | 40 000                        | 63 000                           | 27  | 82  | 164   | 78  | 238   | 484   | 66,4   | 98    | 126,6 |
| 46                    | 62                    | 1              | 0,3             | 50,8            | 20,9                   | 11,2                     | 22 000                        | 34 000                           | 101   | 344 | 698   | 312   | 1 157 | 2 515 | 43,2   | 75,6  | 108,9 |
| 46                    | 62                    | 1              | 0,3             | 50,8            | 19,9                   | 10,6                     | 20 000                        | 30 000                           | 141   | 543 | 1 170 | 410   | 1 640 | 3 663 | 98,6   | 164,8 | 226,8 |
| 46                    | 62                    | 1              | 0,3             | 50,8            | 25,5                   | 10,7                     | 30 000                        | 45 000                           | 49  | 188 | 402   | 146   | 597   | 1 350 | 36,1   | 63,1  | 89,9  |
| 46                    | 62                    | 1              | 0,3             | 50,8            | 24,4                   | 10,2                     | 28 000                        | 43 000                           | 55  | 271 | 622   | 159   | 797   | 1 875 | 80   | 141,7 | 195,1 |
| 46                    | 62                    | 1              | 0,3             | 50,8            | 19,5                   | 10,1                     | 26 000                        | 40 000                           | 91  | 273 | 546   | 268   | 833   | 1 721 | 59,8   | 91,7  | 122,9 |
| 46                    | 62                    | 1              | 0,3             | 50,8            | 19,5                   | 10,1                     | 32 000                        | 50 000                           | 64  | 191 | 382   | 185   | 571   | 1 173 | 59,1   | 89,2  | 117,8 |
| 46                    | 62                    | 1              | 0,3             | 52              | 9,4                    | 5,7                      | 30 000                        | 45 000                           | 34  | 101 | 201   | 100   | 316   | 659   | 30,1   | 47,4  | 64,9  |
| 46                    | 62                    | 1              | 0,3             | 52              | 8,9                    | 5,4                      | 26 000                        | 40 000                           | 53  | 160 | 321   | 154   | 472   | 964   | 74,7   | 111,4 | 145,4 |
| 46                    | 62                    | 1              | 0,3             | 52              | 8,9                    | 5,2                      | 34 000                        | 53 000                           | 37  | 110 | 221   | 106   | 321   | 652   | 74,2   | 109,5 | 141,5 |
| 46                    | 62                    | 1              | 0,3             | 52              | 13,7                   | 5,2                      | 38 000                        | 60 000                           | 37  | 110 | 221   | 106   | 321   | 652   | 74,2   | 109,5 | 141,5 |
| 48                    | 72                    | 1              | 1               | 56,7            | 32,5                   | 16,1                     | 18 000                        | 30 000                           | 175   | 566 | 1 128 | 544   | 1 920 | 4 102 | 49,2   | 84,7  | 121,5 |
| 48                    | 72                    | 1              | 1               | 56,7            | 31                     | 15,4                     | 17 000                        | 28 000                           | 257   | 906 | 1 903 | 750   | 2 748 | 5 985 | 113,5  | 184,3 | 251,6 |
| 48                    | 72                    | 1              | 1               | 56,7            | 32,5                   | 15,4                     | 24 000                        | 38 000                           | 89  | 312 | 650   | 266   | 996   | 2 193 | 41,6   | 70,6  | 99,8  |
| 48                    | 72                    | 1              | 1               | 56,7            | 31                     | 14,7                     | 20 000                        | 34 000                           | 121   | 485 | 1 059 | 347   | 1 432 | 3 208 | 97,6   | 162,1 | 205,4 |

# Spindle bearings

With large or small balls  
 Steel or ceramic balls  
 Steel or Cronidur rings  
 Open or sealed  
 Design DLR



**Dimension table** (continued) · Dimensions in mm

| Designation <sup>1)2)</sup> |                         |                        | Mass<br>m<br>≈ kg | Dimensions |    |    |     |                |                |                | Contact angle<br>α<br>° |                |
|-----------------------------|-------------------------|------------------------|-------------------|------------|----|----|-----|----------------|----------------|----------------|-------------------------|----------------|
| Series 719                  | Series 70               | Series 72              |                   | d          | D  | B  | r   | r <sub>1</sub> | B <sub>N</sub> | S <sub>N</sub> |                         | S <sub>B</sub> |
| <b>B71909-C-T-P4S</b>       | –                       | –                      | 0,117             | <b>45</b>  | 68 | 12 | 0,6 | 0,6            | –              | –              | –                       | 15             |
| <b>B71909-E-T-P4S</b>       | –                       | –                      | 0,116             | <b>45</b>  | 68 | 12 | 0,6 | 0,6            | –              | –              | –                       | 25             |
| <b>HCB71909-C-T-P4S</b>     | –                       | –                      | 0,109             | <b>45</b>  | 68 | 12 | 0,6 | 0,6            | 2,2            | 6,6            | 1,4                     | 15             |
| <b>HCB71909-E-T-P4S</b>     | –                       | –                      | 0,108             | <b>45</b>  | 68 | 12 | 0,6 | 0,6            | 2,2            | 6,6            | 1,4                     | 25             |
| <b>RS71909-D-T-P4S</b>      | –                       | –                      | 0,12              | <b>45</b>  | 68 | 12 | 0,6 | 0,6            | –              | –              | –                       | 20             |
| <b>HCRS71909-D-T-P4S</b>    | –                       | –                      | 0,11              | <b>45</b>  | 68 | 12 | 0,6 | 0,6            | 2,2            | 6,6            | 1,4                     | 20             |
| <b>HS71909-C-T-P4S</b>      | –                       | –                      | 0,136             | <b>45</b>  | 68 | 12 | 0,6 | –              | –              | –              | –                       | 15             |
| <b>HS71909-E-T-P4S</b>      | –                       | –                      | 0,136             | <b>45</b>  | 68 | 12 | 0,6 | –              | –              | –              | –                       | 25             |
| <b>HC71909-E-T-P4S</b>      | –                       | –                      | 0,14              | <b>45</b>  | 68 | 12 | 0,6 | –              | 2,2            | 6,6            | 1,4                     | 25             |
| <b>XC71909-E-T-P4S</b>      | –                       | –                      | 0,14              | <b>45</b>  | 68 | 12 | 0,6 | –              | 2,2            | 6,6            | 1,4                     | 25             |
| –                           | <b>B7009-C-T-P4S</b>    | –                      | 0,238             | <b>45</b>  | 75 | 16 | 1   | 1              | –              | –              | –                       | 15             |
| –                           | <b>B7009-E-T-P4S</b>    | –                      | 0,237             | <b>45</b>  | 75 | 16 | 1   | 1              | –              | –              | –                       | 25             |
| –                           | <b>HCB7009-C-T-P4S</b>  | –                      | 0,197             | <b>45</b>  | 75 | 16 | 1   | 1              | 3,4            | 9,3            | 1,4                     | 15             |
| –                           | <b>HCB7009-E-T-P4S</b>  | –                      | 0,197             | <b>45</b>  | 75 | 16 | 1   | 1              | 3,4            | 9,3            | 1,4                     | 25             |
| –                           | <b>RS7009-D-T-P4S</b>   | –                      | 0,24              | <b>45</b>  | 75 | 16 | 1   | 1              | –              | –              | –                       | 20             |
| –                           | <b>HCRS7009-D-T-P4S</b> | –                      | 0,24              | <b>45</b>  | 75 | 16 | 1   | 1              | –              | –              | –                       | 20             |
| –                           | <b>HS7009-C-T-P4S</b>   | –                      | 0,262             | <b>45</b>  | 75 | 16 | 1   | –              | –              | –              | –                       | 15             |
| –                           | <b>HS7009-E-T-P4S</b>   | –                      | 0,261             | <b>45</b>  | 75 | 16 | 1   | –              | –              | –              | –                       | 25             |
| –                           | <b>HC7009-E-T-P4S</b>   | –                      | 0,277             | <b>45</b>  | 75 | 16 | 1   | –              | 3,4            | 9,3            | 1,4                     | 25             |
| –                           | <b>XC7009-E-T-P4S</b>   | –                      | 0,277             | <b>45</b>  | 75 | 16 | 1   | –              | 3,4            | 9,3            | 1,4                     | 25             |
| –                           | –                       | <b>B7209-C-T-P4S</b>   | 0,423             | <b>45</b>  | 85 | 19 | 1,1 | 1,1            | –              | –              | –                       | 15             |
| –                           | –                       | <b>B7209-E-T-P4S</b>   | 0,422             | <b>45</b>  | 85 | 19 | 1,1 | 1,1            | –              | –              | –                       | 25             |
| –                           | –                       | <b>HCB7209-C-T-P4S</b> | 0,37              | <b>45</b>  | 85 | 19 | 1,1 | 1,1            | –              | –              | –                       | 15             |
| –                           | –                       | <b>HCB7209-E-T-P4S</b> | 0,369             | <b>45</b>  | 85 | 19 | 1,1 | 1,1            | –              | –              | –                       | 25             |

<sup>1)</sup> Explanation of short designations, see page 130.

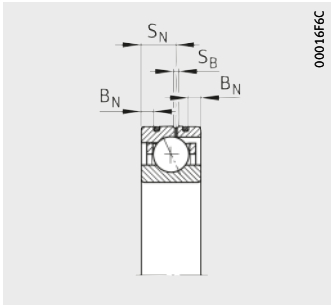
<sup>2)</sup> The bearings are also available with gap seals (type HSS, HCS, XCS or suffix 2RSD).  
 Ordering examples: B7009-C-2RSD-T-P4S-UL and HSS7009-E-T-P4S-UL.

<sup>3)</sup> The limiting speeds in the dimension tables are based on elastically preloaded single bearings.

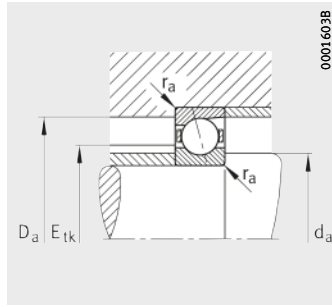
<sup>4)</sup> Explanation, see page 62.

<sup>5)</sup> Minimal quantity oil lubrication.

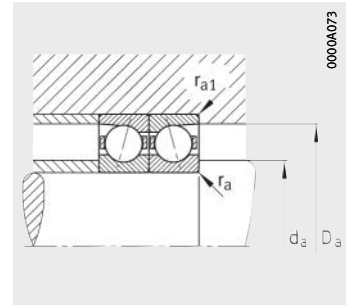
<sup>6)</sup> Ordering examples for Direct Lube design: HCB7009-EDLR-T-P4S-UL and HC7009-EDLR-T-P4S-UL.  
 DLR only up to bore code 22.



Design DLR<sup>6)</sup>



Mounting dimensions



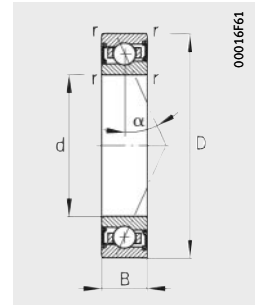
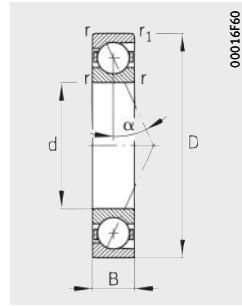
Mounting dimensions



| Mounting dimensions   |                       |                |                 |                 | Basic load ratings     |                          | Limiting speeds <sup>3)</sup> |                                  | Preload force <sup>4)</sup><br>F <sub>v</sub> |     |       | Lift-off force <sup>4)</sup><br>K <sub>aE</sub> |       |       | Axial rigidity <sup>4)</sup><br>c <sub>a</sub> |       |        |
|-----------------------|-----------------------|----------------|-----------------|-----------------|------------------------|--------------------------|-------------------------------|----------------------------------|---|-----|-------|---|-------|-------|--|-------|--------|
| d <sub>a</sub><br>h12 | D <sub>a</sub><br>H12 | r <sub>a</sub> | r <sub>a1</sub> | E <sub>tk</sub> | dyn.<br>C <sub>r</sub> | stat.<br>C <sub>0r</sub> | n <sub>G</sub> grease         | n <sub>G</sub> oil <sup>5)</sup> | L   | M   | H     | L   | M     | H     | L  | M     | H      |
|                       |                       | max.           | nom.            |                 | kN                     | kN                       | min <sup>-1</sup>             | min <sup>-1</sup>                | N   | N   | N     | N   | N     | N     | N/μm   | N/μm  | N/μm   |
| 50                    | 63,5                  | 0,6            | 0,6             | 54,5            | 19,1                   | 11,2                     | 20 000                        | 32 000                           | 88  | 307 | 628   | 270   | 1 027 | 2 251 | 44   | 77,5  | 111,8  |
| 50                    | 63,5                  | 0,6            | 0,6             | 54,5            | 18,2                   | 10,6                     | 19 000                        | 28 000                           | 116   | 470 | 1 028 | 336   | 1 415 | 3 203 | 99   | 168   | 231,9  |
| 50                    | 63,5                  | 0,6            | 0,6             | 54,5            | 19,1                   | 10,7                     | 28 000                        | 45 000                           | 40  | 164 | 355   | 120   | 516   | 1 182 | 36,2   | 64,1  | 91,7   |
| 50                    | 63,5                  | 0,6            | 0,6             | 54,5            | 18,2                   | 10,2                     | 26 000                        | 40 000                           | 42  | 233 | 547   | 121   | 682   | 1 643 | 78,5   | 144,2 | 200    |
| 50                    | 63,5                  | 0,6            | 0,6             | 54,5            | 17,7                   | 9,9                      | 24 000                        | 38 000                           | 82  | 246 | 491   | 241   | 748   | 1 544 | 62   | 94,9  | 126,9  |
| 50                    | 63,5                  | 0,6            | 0,6             | 54,5            | 17,7                   | 9,5                      | 32 000                        | 48 000                           | 57  | 171 | 341   | 165   | 509   | 1 044 | 61,1   | 92,1  | 107,4  |
| 50                    | 63,5                  | 0,6            | 0,6             | 54,5            | 9,6                    | 6                        | 28 000                        | 43 000                           | 34  | 101 | 201   | 100   | 316   | 657   | 30,8   | 48,4  | 66,2   |
| 50                    | 63,5                  | 0,6            | 0,6             | 54,5            | 9,1                    | 5,6                      | 26 000                        | 40 000                           | 55  | 164 | 328   | 158   | 482   | 984   | 77,2   | 115   | 150    |
| 50                    | 63,5                  | 0,6            | 0,6             | 54,5            | 9,1                    | 5,4                      | 32 000                        | 50 000                           | 38  | 113 | 226   | 108   | 329   | 667   | 76,6   | 113,1 | 146,1  |
| 50                    | 63,5                  | 0,6            | 0,6             | 54,5            | 13,9                   | 5,4                      | 36 000                        | 56 000                           | 38  | 113 | 226   | 108   | 329   | 667   | 76,6   | 113,1 | 146,1  |
| 51                    | 69                    | 1              | 0,3             | 56,2            | 28                     | 14,9                     | 19 000                        | 30 000                           | 144   | 476 | 958   | 445   | 1 606 | 3 461 | 49,8   | 86,3  | 123,91 |
| 51                    | 69                    | 1              | 0,3             | 56,2            | 26,5                   | 14,2                     | 17 000                        | 26 000                           | 208   | 763 | 1 622 | 606   | 2 308 | 5 082 | 115  | 188,9 | 258,7  |
| 51                    | 69                    | 1              | 0,3             | 56,2            | 28                     | 14,3                     | 26 000                        | 40 000                           | 71  | 261 | 549   | 212   | 827   | 1 843 | 41,9   | 71,9  | 101,9  |
| 51                    | 69                    | 1              | 0,3             | 56,2            | 26,5                   | 13,6                     | 24 000                        | 38 000                           | 89  | 389 | 869   | 254   | 1 145 | 2 622 | 95,8   | 163,4 | 223    |
| 51                    | 69                    | 1              | 0,3             | 56,2            | 26,5                   | 13,7                     | 22 000                        | 36 000                           | 123   | 369 | 737   | 361   | 1 124 | 2 323 | 67,4   | 103,4 | 138,6  |
| 51                    | 69                    | 1              | 0,3             | 56,2            | 26,5                   | 13,7                     | 30 000                        | 45 000                           | 85  | 254 | 508   | 246   | 758   | 1 557 | 66,3   | 100   | 131,9  |
| 51                    | 69                    | 1              | 0,3             | 57,7            | 12,3                   | 7,5                      | 26 000                        | 40 000                           | 43  | 130 | 259   | 130   | 409   | 853   | 34,3   | 54,1  | 74,3   |
| 51                    | 69                    | 1              | 0,3             | 57,7            | 11,6                   | 7,1                      | 24 000                        | 36 000                           | 70  | 210 | 421   | 203   | 621   | 1 269 | 85,4   | 127,6 | 166,7  |
| 51                    | 69                    | 1              | 0,3             | 57,7            | 11,6                   | 6,8                      | 30 000                        | 48 000                           | 48  | 143 | 286   | 137   | 417   | 848   | 84,4   | 124,7 | 161,3  |
| 51                    | 69                    | 1              | 0,3             | 57,7            | 17,8                   | 6,8                      | 34 000                        | 53 000                           | 48  | 143 | 286   | 137   | 417   | 848   | 84,4   | 124,7 | 161,3  |
| 52,5                  | 78                    | 1              | 1               | 61,8            | 34                     | 17,7                     | 17 000                        | 28 000                           | 182   | 592 | 1 182 | 567   | 2 003 | 4 286 | 52,2   | 90    | 128,9  |
| 52,5                  | 78                    | 1              | 1               | 61,8            | 32,5                   | 16,9                     | 15 000                        | 24 000                           | 268   | 948 | 1 994 | 782   | 2 873 | 6 261 | 120,8  | 196,1 | 267,8  |
| 52,5                  | 78                    | 1              | 1               | 61,8            | 34                     | 17                       | 22 000                        | 36 000                           | 93  | 329 | 685   | 279   | 1 047 | 2 307 | 44,4   | 75,3  | 106,4  |
| 52,5                  | 78                    | 1              | 1               | 61,8            | 32,5                   | 16,2                     | 18 000                        | 30 000                           | 123   | 500 | 1 095 | 354   | 1 475 | 3 312 | 103,2  | 171,7 | 217,2  |

# Spindle bearings

With large or small balls  
 Steel or ceramic balls  
 Steel or Cronidur rings  
 Open or sealed  
 Design DLR



**Dimension table** (continued) · Dimensions in mm

| Designation <sup>1)2)</sup> |                         |                        | Mass<br>m<br>≈ kg | Dimensions |    |    |     |                |                |                |                | Contact angle<br>α<br>° |
|-----------------------------|-------------------------|------------------------|-------------------|------------|----|----|-----|----------------|----------------|----------------|----------------|-------------------------|
| Series 719                  | Series 70               | Series 72              |                   | d          | D  | B  | r   | r <sub>1</sub> | B <sub>N</sub> | S <sub>N</sub> | S <sub>B</sub> |                         |
| <b>B71910-C-T-P4S</b>       | –                       | –                      | 0,117             | <b>50</b>  | 72 | 12 | 0,6 | 0,6            | –              | –              | –              | 15                      |
| <b>B71910-E-T-P4S</b>       | –                       | –                      | 0,083             | <b>50</b>  | 72 | 12 | 0,6 | 0,6            | –              | –              | –              | 25                      |
| <b>HCB71910-C-T-P4S</b>     | –                       | –                      | 0,108             | <b>50</b>  | 72 | 12 | 0,6 | 0,6            | 2,2            | 6,6            | 1,4            | 15                      |
| <b>HCB71910-E-T-P4S</b>     | –                       | –                      | 0,108             | <b>50</b>  | 72 | 12 | 0,6 | 0,6            | 2,2            | 6,6            | 1,4            | 25                      |
| <b>RS71910-D-T-P4S</b>      | –                       | –                      | 0,13              | <b>50</b>  | 72 | 12 | 0,6 | 0,6            | –              | –              | –              | 20                      |
| <b>HCRS71910-D-T-P4S</b>    | –                       | –                      | 0,115             | <b>50</b>  | 72 | 12 | 0,6 | 0,6            | 2,2            | 6,6            | 1,4            | 20                      |
| <b>HS71910-C-T-P4S</b>      | –                       | –                      | 0,138             | <b>50</b>  | 72 | 12 | 0,6 | –              | –              | –              | –              | 15                      |
| <b>HS71910-E-T-P4S</b>      | –                       | –                      | 0,138             | <b>50</b>  | 72 | 12 | 0,6 | –              | –              | –              | –              | 25                      |
| <b>HC71910-E-T-P4S</b>      | –                       | –                      | 0,143             | <b>50</b>  | 72 | 12 | 0,6 | –              | 2,2            | 6,6            | 1,4            | 25                      |
| <b>XC71910-E-T-P4S</b>      | –                       | –                      | 0,143             | <b>50</b>  | 72 | 12 | 0,6 | –              | 2,2            | 6,6            | 1,4            | 25                      |
| –                           | <b>B7010-C-T-P4S</b>    | –                      | 0,257             | <b>50</b>  | 80 | 16 | 1   | 1              | –              | –              | –              | 15                      |
| –                           | <b>B7010-E-T-P4S</b>    | –                      | 0,256             | <b>50</b>  | 80 | 16 | 1   | 1              | –              | –              | –              | 25                      |
| –                           | <b>HCB7010-C-T-P4S</b>  | –                      | 0,214             | <b>50</b>  | 80 | 16 | 1   | 1              | 3,4            | 9,3            | 1,4            | 15                      |
| –                           | <b>HCB7010-E-T-P4S</b>  | –                      | 0,213             | <b>50</b>  | 80 | 16 | 1   | 1              | 3,4            | 9,3            | 1,4            | 25                      |
| –                           | <b>RS7010-D-T-P4S</b>   | –                      | 0,25              | <b>50</b>  | 80 | 16 | 1   | 1              | –              | –              | –              | 20                      |
| –                           | <b>HCRS7010-D-T-P4S</b> | –                      | 0,25              | <b>50</b>  | 80 | 16 | 1   | 1              | 3,4            | 9,3            | 1,4            | 20                      |
| –                           | <b>HS7010-C-T-P4S</b>   | –                      | 0,283             | <b>50</b>  | 80 | 16 | 1   | –              | –              | –              | –              | 15                      |
| –                           | <b>HS7010-E-T-P4S</b>   | –                      | 0,282             | <b>50</b>  | 80 | 16 | 1   | –              | –              | –              | –              | 25                      |
| –                           | <b>HC7010-E-T-P4S</b>   | –                      | 0,3               | <b>50</b>  | 80 | 16 | 1   | –              | 3,4            | 9,3            | 1,4            | 25                      |
| –                           | <b>XC7010-E-T-P4S</b>   | –                      | 0,3               | <b>50</b>  | 80 | 16 | 1   | –              | 3,4            | 9,3            | 1,4            | 25                      |
| –                           | –                       | <b>B7210-C-T-P4S</b>   | 0,448             | <b>50</b>  | 90 | 20 | 1,1 | 1,1            | –              | –              | –              | 15                      |
| –                           | –                       | <b>B7210-E-T-P4S</b>   | 0,446             | <b>50</b>  | 90 | 20 | 1,1 | 1,1            | –              | –              | –              | 25                      |
| –                           | –                       | <b>HCB7210-C-T-P4S</b> | 0,384             | <b>50</b>  | 90 | 20 | 1,1 | 1,1            | –              | –              | –              | 15                      |
| –                           | –                       | <b>HCB7210-E-T-P4S</b> | 0,382             | <b>50</b>  | 90 | 20 | 1,1 | 1,1            | –              | –              | –              | 25                      |

<sup>1)</sup> Explanation of short designations, see page 130.

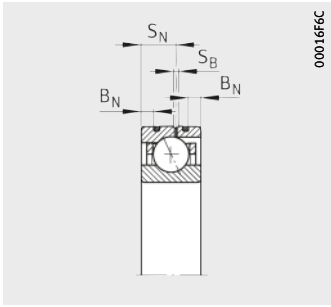
<sup>2)</sup> The bearings are also available with gap seals (type HSS, HCS, XCS or suffix 2RSD).  
 Ordering examples: B7010-C-2RSD-T-P4S-UL and HSS7010-E-T-P4S-UL.

<sup>3)</sup> The limiting speeds in the dimension tables are based on elastically preloaded single bearings.

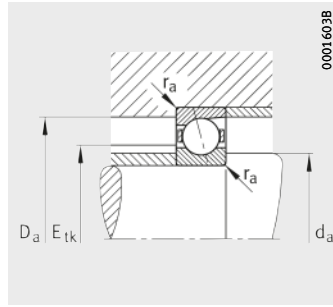
<sup>4)</sup> Explanation, see page 62.

<sup>5)</sup> Minimal quantity oil lubrication.

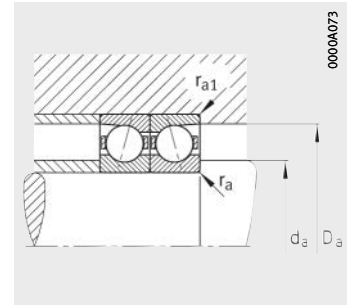
<sup>6)</sup> Ordering examples for Direct Lube design: HCB7010-EDLR-T-P4S-UL and HC7010-EDLR-T-P4S-UL.  
 DLR only up to bore code 22.



Design DLR<sup>6)</sup>



Mounting dimensions



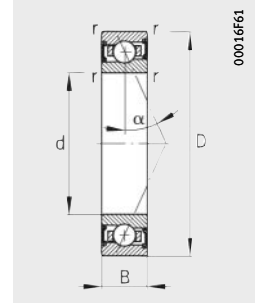
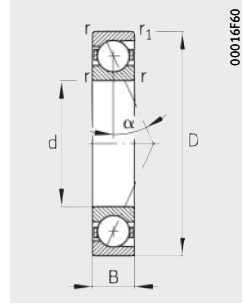
Mounting dimensions



| Mounting dimensions   |                       |                |                 |                 | Basic load ratings     |                          | Limiting speeds <sup>3)</sup> |                                  | Preload force <sup>4)</sup><br>F <sub>V</sub> |       |       | Lift-off force <sup>4)</sup><br>K <sub>aE</sub> |       |       | Axial rigidity <sup>4)</sup><br>c <sub>a</sub> |       |        |
|-----------------------|-----------------------|----------------|-----------------|-----------------|------------------------|--------------------------|-------------------------------|----------------------------------|---|-------|-------|---|-------|-------|--|-------|--------|
| d <sub>a</sub><br>h12 | D <sub>a</sub><br>H12 | r <sub>a</sub> | r <sub>a1</sub> | E <sub>tk</sub> | dyn.<br>C <sub>r</sub> | stat.<br>C <sub>0r</sub> | n <sub>G</sub> grease         | n <sub>G</sub> oil <sup>5)</sup> | L   | M     | H     | L   | M     | H     | L  | M     | H      |
|                       |                       | max.           |                 | nom.            | kN                     | kN                       | min <sup>-1</sup>             | min <sup>-1</sup>                | N   | N     | N     | N   | N     | N     | N/μm   | N/μm  | N/μm   |
| 55                    | 67,5                  | 0,6            | 0,6             | 58,9            | 19,6                   | 11,9                     | 19 000                        | 30 000                           | 89  | 313   | 642   | 274   | 1 044 | 2 293 | 45,6   | 80,2  | 115,7  |
| 55                    | 67,5                  | 0,6            | 0,6             | 58,9            | 18,6                   | 11,3                     | 17 000                        | 26 000                           | 117   | 479   | 1 049 | 340   | 1 439 | 3 263 | 102,5  | 174,3 | 240,5  |
| 55                    | 67,5                  | 0,6            | 0,6             | 58,9            | 19,6                   | 11,4                     | 26 000                        | 40 000                           | 41  | 167   | 362   | 121   | 525   | 1 205 | 37,5   | 66,4  | 95     |
| 55                    | 67,5                  | 0,6            | 0,6             | 58,9            | 18,6                   | 10,8                     | 24 000                        | 36 000                           | 40  | 229   | 542   | 115   | 671   | 1 626 | 79,7   | 147,9 | 205,3  |
| 55                    | 67,5                  | 0,6            | 0,6             | 58,9            | 18,1                   | 10,5                     | 22 000                        | 34 000                           | 85  | 254   | 508   | 249   | 772   | 1 594 | 64,7   | 99    | 132,4  |
| 55                    | 67,5                  | 0,6            | 0,6             | 58,9            | 18,1                   | 10,1                     | 28 000                        | 45 000                           | 58  | 173   | 347   | 168   | 516   | 1 059 | 63,4   | 95,5  | 111    |
| 55                    | 67,5                  | 0,6            | 0,6             | 59              | 9,9                    | 6,5                      | 26 000                        | 40 000                           | 35  | 105   | 209   | 104   | 328   | 682   | 32,6   | 51,2  | 70     |
| 55                    | 67,5                  | 0,6            | 0,6             | 59              | 9,4                    | 6,1                      | 24 000                        | 36 000                           | 56  | 169   | 338   | 163   | 497   | 1 014 | 81,7   | 121,7 | 158,6  |
| 55                    | 67,5                  | 0,6            | 0,6             | 59              | 9,4                    | 5,8                      | 30 000                        | 48 000                           | 39  | 116   | 231   | 110   | 336   | 682   | 80,9   | 119,4 | 154,1  |
| 55                    | 67,5                  | 0,6            | 0,6             | 59              | 14,3                   | 5,8                      | 34 000                        | 53 000                           | 39  | 116   | 231   | 110   | 336   | 682   | 80,9   | 119,4 | 154,1  |
| 56                    | 74                    | 1              | 0,3             | 61,2            | 29                     | 16,1                     | 18 000                        | 28 000                           | 148   | 493   | 994   | 459   | 1 659 | 3 579 | 52,3   | 90,5  | 129,93 |
| 56                    | 74                    | 1              | 0,3             | 61,2            | 27,5                   | 15,3                     | 16 000                        | 24 000                           | 209   | 774   | 1 648 | 610   | 2 336 | 5 151 | 119,8  | 197   | 269,6  |
| 56                    | 74                    | 1              | 0,3             | 61,2            | 29                     | 15,4                     | 24 000                        | 38 000                           | 73  | 268   | 566   | 217   | 848   | 1 894 | 43,9   | 75,3  | 106,6  |
| 56                    | 74                    | 1              | 0,3             | 61,2            | 27,5                   | 14,7                     | 22 000                        | 34 000                           | 90  | 400   | 895   | 259   | 1 175 | 2 697 | 100,2  | 171,4 | 234    |
| 56                    | 74                    | 1              | 0,3             | 61,2            | 27,5                   | 14,8                     | 20 000                        | 32 000                           | 127   | 382   | 764   | 375   | 1 164 | 2 406 | 71   | 108,8 | 145,7  |
| 56                    | 74                    | 1              | 0,3             | 61,2            | 27,5                   | 14,1                     | 26 000                        | 43 000                           | 88  | 263   | 527   | 255   | 786   | 1 614 | 69,8   | 105,3 | 138,8  |
| 56                    | 74                    | 1              | 0,3             | 62,7            | 12,8                   | 8,2                      | 24 000                        | 38 000                           | 45  | 135   | 269   | 135   | 424   | 884   | 36,4   | 57,4  | 78,8   |
| 56                    | 74                    | 1              | 0,3             | 62,7            | 12,1                   | 7,7                      | 22 000                        | 34 000                           | 72  | 216   | 431   | 208   | 635   | 1 297 | 90,6   | 135,1 | 176,3  |
| 56                    | 74                    | 1              | 0,3             | 62,7            | 12,1                   | 7,4                      | 28 000                        | 43 000                           | 50  | 149   | 298   | 143   | 435   | 883   | 90   | 132,9 | 171,9  |
| 56                    | 74                    | 1              | 0,3             | 62,7            | 18,4                   | 7,4                      | 32 000                        | 48 000                           | 50  | 149   | 298   | 143   | 435   | 883   | 90   | 132,9 | 171,9  |
| 57                    | 83                    | 1              | 1               | 66,2            | 43                     | 22,4                     | 16 000                        | 26 000                           | 240   | 771   | 1 534 | 746   | 2 606 | 5 556 | 59,9   | 102,6 | 146,8  |
| 57                    | 83                    | 1              | 1               | 66,2            | 41                     | 21,4                     | 14 000                        | 22 000                           | 352   | 1 221 | 2 553 | 1 027   | 3 697 | 8 006 | 138,3  | 222,9 | 303,3  |
| 57                    | 83                    | 1              | 1               | 66,2            | 43                     | 21,4                     | 20 000                        | 34 000                           | 126   | 434   | 898   | 377   | 1 383 | 3 027 | 51,4   | 86,5  | 121,8  |
| 57                    | 83                    | 1              | 1               | 66,2            | 41                     | 20,4                     | 17 000                        | 28 000                           | 168   | 656   | 1 420 | 484   | 1 933 | 4 292 | 119,9  | 196,5 | 249,7  |

# Spindle bearings

With large or small balls  
 Steel or ceramic balls  
 Steel or Cronidur rings  
 Open or sealed  
 Design DLR



**Dimension table** (continued) · Dimensions in mm

| Designation <sup>1)2)</sup> |                         |                        | Mass<br>m<br>≈ kg | Dimensions |     |    |     |                |                |                |                | Contact angle<br>α<br>° |
|-----------------------------|-------------------------|------------------------|-------------------|------------|-----|----|-----|----------------|----------------|----------------|----------------|-------------------------|
| Series 719                  | Series 70               | Series 72              |                   | d          | D   | B  | r   | r <sub>1</sub> | B <sub>N</sub> | S <sub>N</sub> | S <sub>B</sub> |                         |
| <b>B71911-C-T-P4S</b>       | –                       | –                      | 0,174             | 55         | 80  | 13 | 1   | 1              | –              | –              | –              | 15                      |
| <b>B71911-E-T-P4S</b>       | –                       | –                      | 0,173             | 55         | 80  | 13 | 1   | 1              | –              | –              | –              | 25                      |
| <b>HCB71911-C-T-P4S</b>     | –                       | –                      | 0,15              | 55         | 80  | 13 | 1   | 1              | 2,8            | 7,2            | 1,4            | 15                      |
| <b>HCB71911-E-T-P4S</b>     | –                       | –                      | 0,149             | 55         | 80  | 13 | 1   | 1              | 2,8            | 7,2            | 1,4            | 25                      |
| <b>RS71911-D-T-P4S</b>      | –                       | –                      | 0,18              | 55         | 80  | 13 | 1   | 1              | –              | –              | –              | 20                      |
| <b>HCRS71911-D-T-P4S</b>    | –                       | –                      | 0,15              | 55         | 80  | 13 | 1   | 1              | 2,8            | 7,2            | 1,4            | 20                      |
| <b>HS71911-C-T-P4S</b>      | –                       | –                      | 0,186             | 55         | 80  | 13 | 1   | –              | –              | –              | –              | 15                      |
| <b>HS71911-E-T-P4S</b>      | –                       | –                      | 0,186             | 55         | 80  | 13 | 1   | –              | –              | –              | –              | 25                      |
| <b>HC71911-E-T-P4S</b>      | –                       | –                      | 0,204             | 55         | 80  | 13 | 1   | –              | 2,8            | 7,2            | 1,4            | 25                      |
| <b>XC71911-E-T-P4S</b>      | –                       | –                      | 0,204             | 55         | 80  | 13 | 1   | –              | 2,8            | 7,2            | 1,4            | 25                      |
| –                           | <b>B7011-C-T-P4S</b>    | –                      | 0,377             | 55         | 90  | 18 | 1,1 | 1,1            | –              | –              | –              | 15                      |
| –                           | <b>B7011-E-T-P4S</b>    | –                      | 0,376             | 55         | 90  | 18 | 1,1 | 1,1            | –              | –              | –              | 25                      |
| –                           | <b>HCB7011-C-T-P4S</b>  | –                      | 0,312             | 55         | 90  | 18 | 1,1 | 1,1            | 4,3            | 9,7            | 1,4            | 15                      |
| –                           | <b>HCB7011-E-T-P4S</b>  | –                      | 0,311             | 55         | 90  | 18 | 1,1 | 1,1            | 4,3            | 9,7            | 1,4            | 25                      |
| –                           | <b>RS7011-D-T-P4S</b>   | –                      | 0,38              | 55         | 90  | 18 | 1,1 | 1,1            | –              | –              | –              | 20                      |
| –                           | <b>HCRS7011-D-T-P4S</b> | –                      | 0,38              | 55         | 90  | 18 | 1,1 | 1,1            | 4,3            | 9,7            | 1,4            | 20                      |
| –                           | <b>HS7011-C-T-P4S</b>   | –                      | 0,405             | 55         | 90  | 18 | 1,1 | –              | –              | –              | –              | 15                      |
| –                           | <b>HS7011-E-T-P4S</b>   | –                      | 0,404             | 55         | 90  | 18 | 1,1 | –              | –              | –              | –              | 25                      |
| –                           | <b>HC7011-E-T-P4S</b>   | –                      | 0,429             | 55         | 90  | 18 | 1,1 | –              | 4,3            | 9,7            | 1,4            | 25                      |
| –                           | <b>XC7011-E-T-P4S</b>   | –                      | 0,429             | 55         | 90  | 18 | 1,1 | –              | 4,3            | 9,7            | 1,4            | 25                      |
| –                           | –                       | <b>B7211-C-T-P4S</b>   | 0,619             | 55         | 100 | 21 | 1,5 | 1,5            | –              | –              | –              | 15                      |
| –                           | –                       | <b>B7211-E-T-P4S</b>   | 0,617             | 55         | 100 | 21 | 1,5 | 1,5            | –              | –              | –              | 25                      |
| –                           | –                       | <b>HCB7211-C-T-P4S</b> | 0,546             | 55         | 100 | 21 | 1,5 | 1,5            | –              | –              | –              | 15                      |
| –                           | –                       | <b>HCB7211-E-T-P4S</b> | 0,544             | 55         | 100 | 21 | 1,5 | 1,5            | –              | –              | –              | 25                      |

<sup>1)</sup> Explanation of short designations, see page 130.

<sup>2)</sup> The bearings are also available with gap seals (type HSS, HCS, XCS or suffix 2RSD).  
 Ordering examples: B7011-C-2RSD-T-P4S-UL and HSS7011-E-T-P4S-UL.

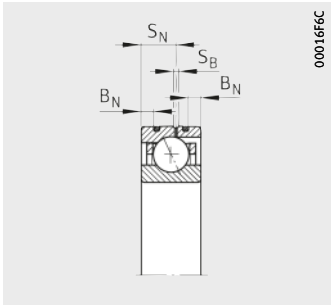
<sup>3)</sup> The limiting speeds in the dimension tables are based on elastically preloaded single bearings.

<sup>4)</sup> Explanation, see page 62.

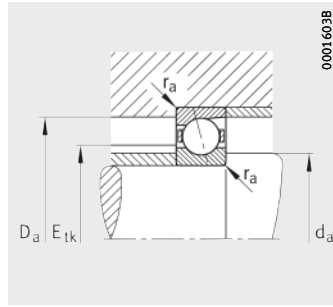
<sup>5)</sup> Minimal quantity oil lubrication.

<sup>6)</sup> Ordering examples for Direct Lube design: HCB7011-EDLR-T-P4S-UL and HC7011-EDLR-T-P4S-UL.  
 DLR only up to bore code 22.

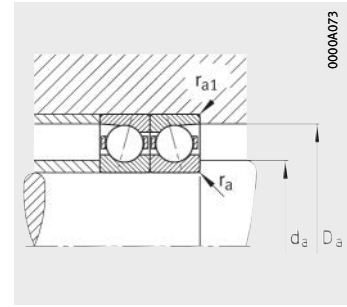




Design DLR<sup>6)</sup>



Mounting dimensions



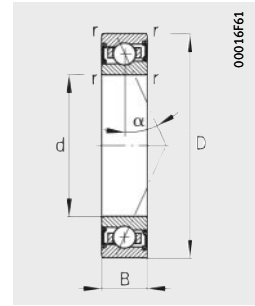
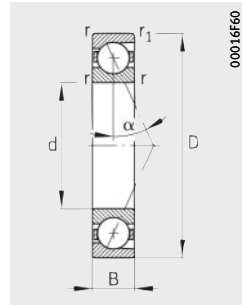
Mounting dimensions



| Mounting dimensions   |                       |                        |                         |                         | Basic load ratings           |                                |  | Limiting speeds <sup>3)</sup>                         |                | Preload force <sup>4)</sup> |       |                 | Lift-off force <sup>4)</sup> |       |                | Axial rigidity <sup>4)</sup> |        |  |
|-----------------------|-----------------------|------------------------|-------------------------|-------------------------|------------------------------|--------------------------------|--|---|----------------|-----------------------------|-------|-----------------|------------------------------|-------|----------------|------------------------------|--------|--|
| d <sub>a</sub><br>h12 | D <sub>a</sub><br>H12 | r <sub>a</sub><br>max. | r <sub>a1</sub><br>max. | E <sub>tk</sub><br>nom. | dyn.<br>C <sub>r</sub><br>kN | stat.<br>C <sub>0r</sub><br>kN | n <sub>G</sub> grease<br>min <sup>-1</sup> | n <sub>G</sub> oil <sup>5)</sup><br>min <sup>-1</sup> | F <sub>v</sub> |                             |       | K <sub>aE</sub> |                              |       | c <sub>a</sub> |                              |        |  |
|                       |                       |                        |                         |                         |                              |                                |  |   | L              | M                           | H     | L               | M                            | H     | L              | M                            | H      |  |
|                       |                       |                        |                         |                         |                              |                                |  |   | N              | N                           | N     | N               | N                            | N     | N/μm           | N/μm                         | N/μm   |  |
| 60                    | 75,5                  | 0,6                    | 0,6                     | 65,1                    | 23,5                         | 14,4                           | 17 000                                     | 26 000  | 111            | 382                         | 780   | 340             | 1 274                        | 2 784 | 50,8           | 88,6                         | 127,6  |  |
| 60                    | 75,5                  | 0,6                    | 0,6                     | 65,1                    | 22,2                         | 13,7                           | 15 000                                     | 24 000  | 149            | 588                         | 1 278 | 431             | 1 768                        | 3 973 | 115,1          | 193,3                        | 265,7  |  |
| 60                    | 75,5                  | 0,6                    | 0,6                     | 65,1                    | 23,5                         | 13,8                           | 24 000                                     | 36 000  | 53             | 208                         | 447   | 157             | 654                          | 1 487 | 42,4           | 74,1                         | 105,5  |  |
| 60                    | 75,5                  | 0,6                    | 0,6                     | 65,1                    | 22,2                         | 13,1                           | 22 000                                     | 32 000  | 57             | 296                         | 686   | 164             | 867                          | 2 058 | 93             | 167                          | 230,4  |  |
| 60                    | 75,5                  | 0,6                    | 0,6                     | 65,1                    | 12,4                         | 6,1                            | 20 000                                     | 32 000  | 102            | 306                         | 612   | 299             | 929                          | 1 917 | 71,2           | 108,9                        | 145,5  |  |
| 60                    | 75,5                  | 0,6                    | 0,6                     | 65,1                    | 21,9                         | 12,5                           | 26 000                                     | 40 000  | 70             | 209                         | 418   | 202             | 622                          | 1 275 | 69,9           | 105,1                        | 123,6  |  |
| 60                    | 75,5                  | 0,6                    | 0,6                     | 65,2                    | 13                           | 8,5                            | 24 000                                     | 36 000  | 45             | 135                         | 269   | 135             | 424                          | 882   | 37,3           | 58,6                         | 80,3   |  |
| 60                    | 75,5                  | 0,6                    | 0,6                     | 65,2                    | 12,3                         | 8                              | 22 000                                     | 32 000  | 73             | 219                         | 438   | 211             | 645                          | 1 317 | 93,2           | 139                          | 181,4  |  |
| 60                    | 75,5                  | 0,6                    | 0,6                     | 65,2                    | 12,3                         | 7,7                            | 28 000                                     | 43 000  | 51             | 152                         | 304   | 145             | 442                          | 897   | 92,7           | 136,9                        | 176,9  |  |
| 60                    | 75,5                  | 0,6                    | 0,6                     | 65,2                    | 18,8                         | 7,7                            | 30 000                                     | 48 000  | 51             | 152                         | 304   | 145             | 442                          | 897   | 92,7           | 136,9                        | 176,9  |  |
| 62                    | 83                    | 1                      | 0,6                     | 68,1                    | 38,5                         | 22,1                           | 16 000                                     | 24 000  | 205            | 670                         | 1 344 | 635             | 2 253                        | 4 837 | 61,4           | 105,5                        | 151,07 |  |
| 62                    | 83                    | 1                      | 0,6                     | 68,1                    | 37                           | 21                             | 14 000                                     | 22 000  | 296            | 1 059                       | 2 234 | 862             | 3 197                        | 6 983 | 141,7          | 230,3                        | 314    |  |
| 62                    | 83                    | 1                      | 0,6                     | 68,1                    | 38,5                         | 21,2                           | 22 000                                     | 34 000  | 102            | 366                         | 765   | 305             | 1 158                        | 2 559 | 51,9           | 87,9                         | 124    |  |
| 62                    | 83                    | 1                      | 0,6                     | 68,1                    | 37                           | 20,1                           | 20 000                                     | 30 000  | 136            | 562                         | 1 236 | 390             | 1 653                        | 3 728 | 121,2          | 202,5                        | 274,6  |  |
| 62                    | 83                    | 1                      | 0,6                     | 68,1                    | 36                           | 19,8                           | 19 000                                     | 28 000  | 171            | 512                         | 1 024 | 502             | 1 558                        | 3 219 | 82,3           | 126,1                        | 168,8  |  |
| 62                    | 83                    | 1                      | 0,6                     | 68,1                    | 36                           | 18,9                           | 24 000                                     | 38 000  | 116            | 348                         | 696   | 337             | 1 038                        | 2 130 | 80,6           | 121,4                        | 160    |  |
| 62                    | 83                    | 1                      | 0,6                     | 69,7                    | 17,9                         | 11,5                           | 22 000                                     | 34 000  | 62             | 187                         | 374   | 187             | 588                          | 1 225 | 42,2           | 66,5                         | 91,1   |  |
| 62                    | 83                    | 1                      | 0,6                     | 69,7                    | 16,9                         | 10,9                           | 20 000                                     | 30 000  | 101            | 304                         | 607   | 292             | 895                          | 1 826 | 105,6          | 157,4                        | 205,5  |  |
| 62                    | 83                    | 1                      | 0,6                     | 69,7                    | 16,9                         | 10,4                           | 26 000                                     | 40 000  | 70             | 210                         | 421   | 201             | 613                          | 1 244 | 105            | 155,1                        | 200,5  |  |
| 62                    | 83                    | 1                      | 0,6                     | 69,7                    | 26                           | 10,4                           | 28 000                                     | 43 000  | 70             | 210                         | 421   | 201             | 613                          | 1 244 | 105            | 155,1                        | 200,5  |  |
| 63                    | 92                    | 1,5                    | 1,5                     | 73,7                    | 47                           | 26,5                           | 14 000                                     | 22 000  | 258            | 832                         | 1 662 | 800             | 2 800                        | 5 985 | 66,7           | 114                          | 163    |  |
| 63                    | 92                    | 1,5                    | 1,5                     | 73,7                    | 45                           | 25                             | 13 000                                     | 20 000  | 378            | 1 321                       | 2 767 | 1 103           | 3 991                        | 8 652 | 154,6          | 249,2                        | 338,8  |  |
| 63                    | 92                    | 1,5                    | 1,5                     | 73,7                    | 47                           | 25                             | 18 000                                     | 30 000  | 132            | 460                         | 956   | 395             | 1 460                        | 3 203 | 56,9           | 95,6                         | 134,5  |  |
| 63                    | 92                    | 1,5                    | 1,5                     | 73,7                    | 45                           | 24                             | 15 000                                     | 24 000  | 180            | 709                         | 1 540 | 518             | 2 088                        | 4 646 | 133,8          | 219,9                        | 279    |  |

# Spindle bearings

With large or small balls  
 Steel or ceramic balls  
 Steel or Cronidur rings  
 Open or sealed  
 Design DLR



**Dimension table** (continued) · Dimensions in mm

| Designation <sup>1)2)</sup> |                         |                        | Mass<br>m<br>≈ kg | Dimensions |     |    |     |                |                |                |                | Contact angle<br>α<br>° |
|-----------------------------|-------------------------|------------------------|-------------------|------------|-----|----|-----|----------------|----------------|----------------|----------------|-------------------------|
| Series 719                  | Series 70               | Series 72              |                   | d          | D   | B  | r   | r <sub>1</sub> | B <sub>N</sub> | S <sub>N</sub> | S <sub>B</sub> |                         |
| <b>B71912-C-T-P4S</b>       | –                       | –                      | 0,188             | <b>60</b>  | 85  | 13 | 1   | 1              | –              | –              | –              | 15                      |
| <b>B71912-E-T-P4S</b>       | –                       | –                      | 0,187             | <b>60</b>  | 85  | 13 | 1   | 1              | –              | –              | –              | 25                      |
| <b>HCB71912-C-T-P4S</b>     | –                       | –                      | 0,161             | <b>60</b>  | 85  | 13 | 1   | 1              | 2,8            | 7,2            | 1,4            | 15                      |
| <b>HCB71912-E-T-P4S</b>     | –                       | –                      | 0,16              | <b>60</b>  | 85  | 13 | 1   | 1              | 2,8            | 7,2            | 1,4            | 25                      |
| <b>RS71912-D-T-P4S</b>      | –                       | –                      | 0,195             | <b>60</b>  | 85  | 13 | 1   | 1              | –              | –              | –              | 20                      |
| <b>HCRS71912-D-T-P4S</b>    | –                       | –                      | 0,16              | <b>60</b>  | 85  | 13 | 1   | 1              | 2,8            | 7,2            | 1,4            | 20                      |
| <b>HS71912-C-T-P4S</b>      | –                       | –                      | 0,2               | <b>60</b>  | 85  | 13 | 1   | –              | –              | –              | –              | 15                      |
| <b>HS71912-E-T-P4S</b>      | –                       | –                      | 0,2               | <b>60</b>  | 85  | 13 | 1   | –              | –              | –              | –              | 25                      |
| <b>HC71912-E-T-P4S</b>      | –                       | –                      | 0,22              | <b>60</b>  | 85  | 13 | 1   | –              | 2,8            | 7,2            | 1,4            | 25                      |
| <b>XC71912-E-T-P4S</b>      | –                       | –                      | 0,22              | <b>60</b>  | 85  | 13 | 1   | –              | 2,8            | 7,2            | 1,4            | 25                      |
| –                           | <b>B7012-C-T-P4S</b>    | –                      | 0,401             | <b>60</b>  | 95  | 18 | 1,1 | 1,1            | –              | –              | –              | 15                      |
| –                           | <b>B7012-E-T-P4S</b>    | –                      | 0,4               | <b>60</b>  | 95  | 18 | 1,1 | 1,1            | –              | –              | –              | 25                      |
| –                           | <b>HCB7012-C-T-P4S</b>  | –                      | 0,333             | <b>60</b>  | 95  | 18 | 1,1 | 1,1            | 4,3            | 9,7            | 1,4            | 15                      |
| –                           | <b>HCB7012-E-T-P4S</b>  | –                      | 0,332             | <b>60</b>  | 95  | 18 | 1,1 | 1,1            | 4,3            | 9,7            | 1,4            | 25                      |
| –                           | <b>RS7012-D-T-P4S</b>   | –                      | 0,4               | <b>60</b>  | 95  | 18 | 1,1 | 1,1            | –              | –              | –              | 20                      |
| –                           | <b>HCRS7012-D-T-P4S</b> | –                      | 0,4               | <b>60</b>  | 95  | 18 | 1,1 | 1,1            | 4,3            | 9,7            | 1,4            | 20                      |
| –                           | <b>HS7012-C-T-P4S</b>   | –                      | 0,433             | <b>60</b>  | 95  | 18 | 1,1 | –              | –              | –              | –              | 15                      |
| –                           | <b>HS7012-E-T-P4S</b>   | –                      | 0,433             | <b>60</b>  | 95  | 18 | 1,1 | –              | –              | –              | –              | 25                      |
| –                           | <b>HC7012-E-T-P4S</b>   | –                      | 0,458             | <b>60</b>  | 95  | 18 | 1,1 | –              | 4,3            | 9,7            | 1,4            | 25                      |
| –                           | <b>XC7012-E-T-P4S</b>   | –                      | 0,458             | <b>60</b>  | 95  | 18 | 1,1 | –              | 4,3            | 9,7            | 1,4            | 25                      |
| –                           | –                       | <b>B7212-C-T-P4S</b>   | 0,795             | <b>60</b>  | 110 | 22 | 1,5 | 1,5            | –              | –              | –              | 15                      |
| –                           | –                       | <b>B7212-E-T-P4S</b>   | 0,793             | <b>60</b>  | 110 | 22 | 1,5 | 1,5            | –              | –              | –              | 25                      |
| –                           | –                       | <b>HCB7212-C-T-P4S</b> | 0,687             | <b>60</b>  | 110 | 22 | 1,5 | 1,5            | –              | –              | –              | 15                      |
| –                           | –                       | <b>HCB7212-E-T-P4S</b> | 0,685             | <b>60</b>  | 110 | 22 | 1,5 | 1,5            | –              | –              | –              | 25                      |

<sup>1)</sup> Explanation of short designations, see page 130.

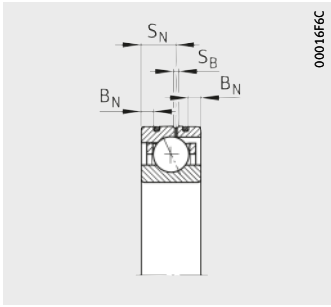
<sup>2)</sup> The bearings are also available with gap seals (type HSS, HCS, XCS or suffix 2RSD).  
 Ordering examples: B7012-C-2RSD-T-P4S-UL and HSS7012-E-T-P4S-UL.

<sup>3)</sup> The limiting speeds in the dimension tables are based on elastically preloaded single bearings.

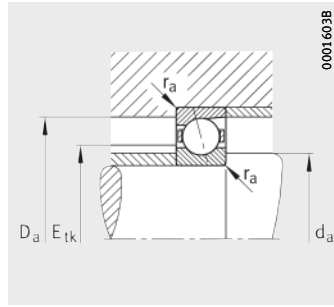
<sup>4)</sup> Explanation, see page 62.

<sup>5)</sup> Minimal quantity oil lubrication.

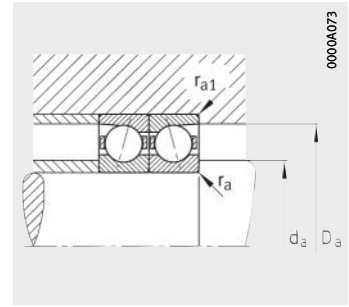
<sup>6)</sup> Ordering examples for Direct Lube design: HCB7012-EDLR-T-P4S-UL and HC7012-EDLR-T-P4S-UL.  
 DLR only up to bore code 22.



Design DLR<sup>6)</sup>



Mounting dimensions



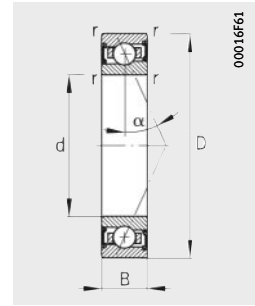
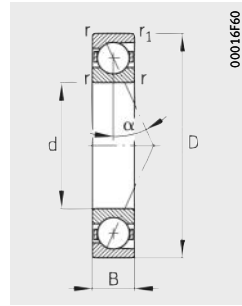
Mounting dimensions



| Mounting dimensions |                |                |                 |                 | Basic load ratings  |                       | Limiting speeds <sup>3)</sup> |                                  | Preload force <sup>4)</sup> |       |       | Lift-off force <sup>4)</sup> |       |        | Axial rigidity <sup>4)</sup> |       |        |
|---------------------|----------------|----------------|-----------------|-----------------|---------------------|-----------------------|-------------------------------|----------------------------------|-----------------------------|-------|-------|------------------------------|-------|--------|------------------------------|-------|--------|
| d <sub>a</sub>      | D <sub>a</sub> | r <sub>a</sub> | r <sub>a1</sub> | E <sub>tk</sub> | dyn. C <sub>r</sub> | stat. C <sub>0r</sub> | n <sub>G</sub> grease         | n <sub>G</sub> oil <sup>5)</sup> | F <sub>V</sub>              |       |       | K <sub>aE</sub>              |       |        | c <sub>a</sub>               |       |        |
| h12                 | H12            | max.           |                 | nom.            | kN                  | kN                    | min <sup>-1</sup>             | min <sup>-1</sup>                | L                           | M     | H     | L                            | M     | H      | L                            | M     | H      |
|                     |                |                |                 |                 |                     |                       |                               |                                  | N                           | N     | N     | N                            | N     | N      | N/μm                         | N/μm  | N/μm   |
| 65                  | 80,5           | 0,6            | 0,6             | 70,1            | 24,7                | 16                    | 16 000                        | 24 000                           | 116                         | 401   | 822   | 354                          | 1 333 | 2 919  | 54,5                         | 95,1  | 136,8  |
| 65                  | 80,5           | 0,6            | 0,6             | 70,1            | 23,4                | 15,2                  | 14 000                        | 22 000                           | 155                         | 617   | 1 344 | 448                          | 1 853 | 4 171  | 123,7                        | 208,1 | 286,1  |
| 65                  | 80,5           | 0,6            | 0,6             | 70,1            | 24,7                | 15,3                  | 22 000                        | 34 000                           | 54                          | 214   | 462   | 159                          | 671   | 1 530  | 45,1                         | 79    | 112,4  |
| 65                  | 80,5           | 0,6            | 0,6             | 70,1            | 23,4                | 14,5                  | 20 000                        | 30 000                           | 57                          | 303   | 707   | 163                          | 887   | 2 118  | 98,5                         | 178,5 | 246,4  |
| 65                  | 80,5           | 0,6            | 0,6             | 70,1            | 23,1                | 14,4                  | 19 000                        | 28 000                           | 106                         | 317   | 633   | 310                          | 960   | 1 980  | 76,4                         | 116,6 | 155,5  |
| 65                  | 80,5           | 0,6            | 0,6             | 70,1            | 23,1                | 13,8                  | 24 000                        | 38 000                           | 74                          | 222   | 445   | 215                          | 662   | 1 357  | 75,8                         | 113,9 | 133,6  |
| 65                  | 80,5           | 0,6            | 0,6             | 70,2            | 13,4                | 9,2                   | 22 000                        | 34 000                           | 47                          | 141   | 281   | 140                          | 442   | 920    | 39,5                         | 62,1  | 85     |
| 65                  | 80,5           | 0,6            | 0,6             | 70,2            | 12,6                | 8,7                   | 20 000                        | 30 000                           | 76                          | 228   | 455   | 219                          | 670   | 1 368  | 98,8                         | 147,2 | 192    |
| 65                  | 80,5           | 0,6            | 0,6             | 70,2            | 12,6                | 8,3                   | 26 000                        | 40 000                           | 52                          | 155   | 311   | 148                          | 452   | 917    | 97,7                         | 144,2 | 186,3  |
| 65                  | 80,5           | 0,6            | 0,6             | 70,2            | 19,4                | 8,3                   | 28 000                        | 43 000                           | 52                          | 155   | 311   | 148                          | 452   | 917    | 97,7                         | 144,2 | 186,3  |
| 67                  | 88             | 1              | 0,6             | 73,1            | 40                  | 23,8                  | 15 000                        | 22 000                           | 209                         | 687   | 1 381 | 647                          | 2 304 | 4 952  | 64                           | 109,9 | 157,36 |
| 67                  | 88             | 1              | 0,6             | 73,1            | 38                  | 22,6                  | 13 000                        | 20 000                           | 297                         | 1 069 | 2 259 | 864                          | 3 221 | 7 045  | 147,1                        | 239,2 | 326    |
| 67                  | 88             | 1              | 0,6             | 73,1            | 40                  | 22,7                  | 20 000                        | 32 000                           | 106                         | 379   | 794   | 315                          | 1 198 | 2 651  | 54,4                         | 92,2  | 130    |
| 67                  | 88             | 1              | 0,6             | 73,1            | 38                  | 21,6                  | 19 000                        | 28 000                           | 136                         | 569   | 1 256 | 391                          | 1 673 | 3 782  | 125,9                        | 210,9 | 286    |
| 67                  | 88             | 1              | 0,6             | 73,1            | 37                  | 21,2                  | 18 000                        | 26 000                           | 173                         | 519   | 1 037 | 508                          | 1 576 | 3 254  | 85,8                         | 131,2 | 175,3  |
| 67                  | 88             | 1              | 0,6             | 73,1            | 37                  | 20,3                  | 22 000                        | 34 000                           | 121                         | 362   | 723   | 350                          | 1 078 | 2 211  | 84,8                         | 127,6 | 168,1  |
| 67                  | 88             | 1              | 0,6             | 74,7            | 18,6                | 12,5                  | 20 000                        | 32 000                           | 65                          | 194   | 388   | 194                          | 609   | 1 269  | 44,8                         | 70,5  | 96,4   |
| 67                  | 88             | 1              | 0,6             | 74,7            | 17,6                | 11,8                  | 18 000                        | 28 000                           | 105                         | 316   | 631   | 304                          | 929   | 1 896  | 112,3                        | 167,3 | 218,3  |
| 67                  | 88             | 1              | 0,6             | 74,7            | 17,6                | 11,3                  | 24 000                        | 36 000                           | 73                          | 219   | 438   | 209                          | 638   | 1 294  | 111,7                        | 165   | 213,1  |
| 67                  | 88             | 1              | 0,6             | 74,7            | 27                  | 11,3                  | 26 000                        | 40 000                           | 73                          | 219   | 438   | 209                          | 638   | 1 294  | 111,7                        | 165   | 213,1  |
| 69,5                | 101,5          | 1,5            | 1,5             | 81,2            | 56                  | 31                    | 13 000                        | 20 000                           | 312                         | 996   | 1 982 | 968                          | 3 352 | 7 140  | 70,9                         | 120,8 | 172,4  |
| 69,5                | 101,5          | 1,5            | 1,5             | 81,2            | 53                  | 29,5                  | 12 000                        | 19 000                           | 463                         | 1 586 | 3 304 | 1 351                        | 4 794 | 10 334 | 164,9                        | 264,1 | 358,3  |
| 69,5                | 101,5          | 1,5            | 1,5             | 81,2            | 56                  | 29,5                  | 16 000                        | 26 000                           | 163                         | 557   | 1 149 | 488                          | 1 767 | 3 852  | 60,9                         | 101,6 | 142,7  |
| 69,5                | 101,5          | 1,5            | 1,5             | 81,2            | 53                  | 28,5                  | 14 000                        | 22 000                           | 226                         | 859   | 1 847 | 651                          | 2 531 | 5 576  | 144                          | 233,8 | 297,7  |

# Spindle bearings

With large or small balls  
 Steel or ceramic balls  
 Steel or Cronidur rings  
 Open or sealed  
 Design DLR



**Dimension table** (continued) · Dimensions in mm

| Designation <sup>1)2)</sup> |                         |                        | Mass<br>m<br>≈ kg | Dimensions |     |    |      |                |                |                |                | Contact angle<br>α<br>° |
|-----------------------------|-------------------------|------------------------|-------------------|------------|-----|----|------|----------------|----------------|----------------|----------------|-------------------------|
| Series 719                  | Series 70               | Series 72              |                   | d          | D   | B  | r    | r <sub>1</sub> | B <sub>N</sub> | S <sub>N</sub> | S <sub>B</sub> |                         |
|                             |                         |                        |                   |            |     |    |      |                |                |                |                |                         |
|                             |                         |                        |                   |            |     |    | min. |                |                |                |                |                         |
| <b>B71913-C-T-P4S</b>       | –                       | –                      | 0,2               | <b>65</b>  | 90  | 13 | 1    | 1              | –              | –              | –              | 15                      |
| <b>B71913-E-T-P4S</b>       | –                       | –                      | 0,199             | <b>65</b>  | 90  | 13 | 1    | 1              | –              | –              | –              | 25                      |
| <b>HCB71913-C-T-P4S</b>     | –                       | –                      | 0,172             | <b>65</b>  | 90  | 13 | 1    | 1              | 2,8            | 7,2            | 1,4            | 15                      |
| <b>HCB71913-E-T-P4S</b>     | –                       | –                      | 0,171             | <b>65</b>  | 90  | 13 | 1    | 1              | 2,8            | 7,2            | 1,4            | 25                      |
| <b>RS71913-D-T-P4S</b>      | –                       | –                      | 0,2               | <b>65</b>  | 90  | 13 | 1    | 1              | –              | –              | –              | 20                      |
| <b>HCRS71913-D-T-P4S</b>    | –                       | –                      | 0,175             | <b>65</b>  | 90  | 13 | 1    | 1              | 2,8            | 7,2            | 1,4            | 20                      |
| <b>HS71913-C-T-P4S</b>      | –                       | –                      | 0,214             | <b>65</b>  | 90  | 13 | 1    | –              | –              | –              | –              | 15                      |
| <b>HS71913-E-T-P4S</b>      | –                       | –                      | 0,214             | <b>65</b>  | 90  | 13 | 1    | –              | –              | –              | –              | 25                      |
| <b>HC71913-E-T-P4S</b>      | –                       | –                      | 0,235             | <b>65</b>  | 90  | 13 | 1    | –              | 2,8            | 7,2            | 1,4            | 25                      |
| <b>XC71913-E-T-P4S</b>      | –                       | –                      | 0,235             | <b>65</b>  | 90  | 13 | 1    | –              | 2,8            | 7,2            | 1,4            | 25                      |
| –                           | <b>B7013-C-T-P4S</b>    | –                      | 0,426             | <b>65</b>  | 100 | 18 | 1,1  | 1,1            | –              | –              | –              | 15                      |
| –                           | <b>B7013-E-T-P4S</b>    | –                      | 0,425             | <b>65</b>  | 100 | 18 | 1,1  | 1,1            | –              | –              | –              | 25                      |
| –                           | <b>HCB7013-C-T-P4S</b>  | –                      | 0,354             | <b>65</b>  | 100 | 18 | 1,1  | 1,1            | 4              | 10,4           | 1,4            | 15                      |
| –                           | <b>HCB7013-E-T-P4S</b>  | –                      | 0,353             | <b>65</b>  | 100 | 18 | 1,1  | 1,1            | 4              | 10,4           | 1,4            | 25                      |
| –                           | <b>RS7013-D-T-P4S</b>   | –                      | 0,43              | <b>65</b>  | 100 | 18 | 1,1  | 1,1            | –              | –              | –              | 20                      |
| –                           | <b>HCRS7013-D-T-P4S</b> | –                      | 0,43              | <b>65</b>  | 100 | 18 | 1,1  | 1,1            | 4              | 10,4           | 1,4            | 20                      |
| –                           | <b>HS7013-C-T-P4S</b>   | –                      | 0,461             | <b>65</b>  | 100 | 18 | 1,1  | –              | –              | –              | –              | 15                      |
| –                           | <b>HS7013-E-T-P4S</b>   | –                      | 0,461             | <b>65</b>  | 100 | 18 | 1,1  | –              | –              | –              | –              | 25                      |
| –                           | <b>HC7013-E-T-P4S</b>   | –                      | 0,488             | <b>65</b>  | 100 | 18 | 1,1  | –              | 4              | 10,4           | 1,4            | 25                      |
| –                           | <b>XC7013-E-T-P4S</b>   | –                      | 0,488             | <b>65</b>  | 100 | 18 | 1,1  | –              | 4              | 10,4           | 1,4            | 25                      |
| –                           | –                       | <b>B7213-C-T-P4S</b>   | 1                 | <b>65</b>  | 120 | 23 | 1,5  | 1,5            | –              | –              | –              | 15                      |
| –                           | –                       | <b>B7213-E-T-P4S</b>   | 0,998             | <b>65</b>  | 120 | 23 | 1,5  | 1,5            | –              | –              | –              | 25                      |
| –                           | –                       | <b>HCB7213-C-T-P4S</b> | 0,866             | <b>65</b>  | 120 | 23 | 1,5  | 1,5            | –              | –              | –              | 15                      |
| –                           | –                       | <b>HCB7213-E-T-P4S</b> | 0,863             | <b>65</b>  | 120 | 23 | 1,5  | 1,5            | –              | –              | –              | 25                      |

<sup>1)</sup> Explanation of short designations, see page 130.

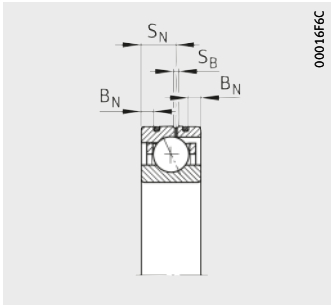
<sup>2)</sup> The bearings are also available with gap seals (type HSS, HCS, XCS or suffix 2RSD).  
 Ordering examples: B7013-C-2RSD-T-P4S-UL and HSS7013-E-T-P4S-UL.

<sup>3)</sup> The limiting speeds in the dimension tables are based on elastically preloaded single bearings.

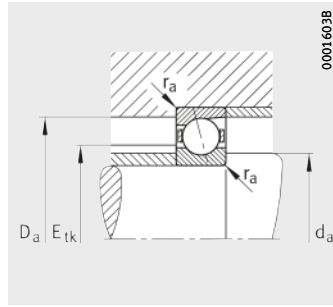
<sup>4)</sup> Explanation, see page 62.

<sup>5)</sup> Minimal quantity oil lubrication.

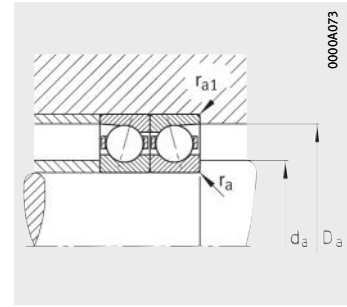
<sup>6)</sup> Ordering examples for Direct Lube design: HCB7013-EDLR-T-P4S-UL and HC7013-EDLR-T-P4S-UL.  
 DLR only up to bore code 22.



Design DLR<sup>6)</sup>



Mounting dimensions



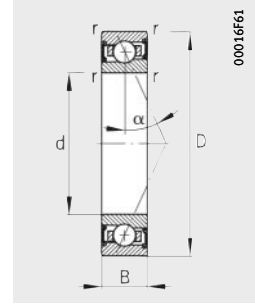
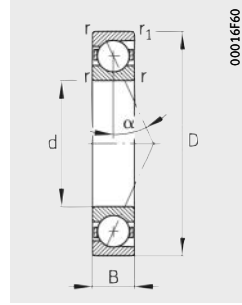
Mounting dimensions



| Mounting dimensions   |                       |                |                 |                 | Basic load ratings     |                          | Limiting speeds <sup>3)</sup> |                                  | Preload force <sup>4)</sup> |       |       | Lift-off force <sup>4)</sup> |       |        | Axial rigidity <sup>4)</sup> |       |        |
|-----------------------|-----------------------|----------------|-----------------|-----------------|------------------------|--------------------------|-------------------------------|----------------------------------|-----------------------------|-------|-------|------------------------------|-------|--------|------------------------------|-------|--------|
| d <sub>a</sub><br>h12 | D <sub>a</sub><br>H12 | r <sub>a</sub> | r <sub>a1</sub> | E <sub>tk</sub> | dyn.<br>C <sub>r</sub> | stat.<br>C <sub>0r</sub> | n <sub>G</sub> grease         | n <sub>G</sub> oil <sup>5)</sup> | L                           | M     | H     | L                            | M     | H      | L                            | M     | H      |
|                       |                       | max.           |                 | nom.            | kN                     | kN                       | min <sup>-1</sup>             | min <sup>-1</sup>                | N                           | N     | N     | N                            | N     | N      | N/μm                         | N/μm  | N/μm   |
| 70                    | 85,5                  | 0,6            | 0,6             | 75,1            | 25                     | 16,9                     | 15 000                        | 22 000                           | 117                         | 409   | 839   | 360                          | 1 356 | 2 973  | 56,2                         | 98,1  | 141,1  |
| 70                    | 85,5                  | 0,6            | 0,6             | 75,1            | 23,7                   | 16                       | 13 000                        | 20 000                           | 152                         | 613   | 1 339 | 440                          | 1 837 | 4 145  | 126,4                        | 213   | 292,7  |
| 70                    | 85,5                  | 0,6            | 0,6             | 75,1            | 25                     | 16,1                     | 20 000                        | 32 000                           | 55                          | 219   | 473   | 161                          | 684   | 1 562  | 46,6                         | 81,7  | 116,1  |
| 70                    | 85,5                  | 0,6            | 0,6             | 75,1            | 23,7                   | 15,3                     | 19 000                        | 28 000                           | 58                          | 309   | 723   | 165                          | 904   | 2 165  | 101,6                        | 184,7 | 255,1  |
| 70                    | 85,5                  | 0,6            | 0,6             | 75,1            | 23,3                   | 15,1                     | 18 000                        | 26 000                           | 113                         | 339   | 678   | 330                          | 1 021 | 2 101  | 86,4                         | 131,1 | 173,9  |
| 70                    | 85,5                  | 0,6            | 0,6             | 75,1            | 23,3                   | 14,5                     | 22 000                        | 34 000                           | 78                          | 234   | 468   | 226                          | 693   | 1 417  | 85,3                         | 127,6 | 148,2  |
| 70                    | 85,5                  | 0,6            | 0,6             | 75,2            | 13,8                   | 9,9                      | 20 000                        | 32 000                           | 48                          | 144   | 287   | 143                          | 450   | 937    | 41,5                         | 65    | 88,8   |
| 70                    | 85,5                  | 0,6            | 0,6             | 75,2            | 13                     | 9,3                      | 18 000                        | 28 000                           | 77                          | 231   | 462   | 222                          | 680   | 1 386  | 103,6                        | 154,2 | 200,9  |
| 70                    | 85,5                  | 0,6            | 0,6             | 75,2            | 13                     | 8,9                      | 24 000                        | 36 000                           | 53                          | 160   | 321   | 153                          | 466   | 946    | 103,1                        | 152,1 | 196,3  |
| 70                    | 85,5                  | 0,6            | 0,6             | 75,2            | 19,9                   | 8,9                      | 26 000                        | 40 000                           | 53                          | 160   | 321   | 153                          | 466   | 946    | 103,1                        | 152,1 | 196,3  |
| 72                    | 93                    | 1              | 0,6             | 78,1            | 41,5                   | 25,5                     | 14 000                        | 22 000                           | 214                         | 704   | 1 417 | 660                          | 2 354 | 5 068  | 66,7                         | 114,4 | 163,62 |
| 72                    | 93                    | 1              | 0,6             | 78,1            | 39                     | 24,1                     | 13 000                        | 19 000                           | 308                         | 1 111 | 2 350 | 896                          | 3 347 | 7 323  | 154,3                        | 251   | 341,9  |
| 72                    | 93                    | 1              | 0,6             | 78,1            | 41,5                   | 24,3                     | 19 000                        | 30 000                           | 107                         | 385   | 808   | 318                          | 1 213 | 2 688  | 56,4                         | 95,6  | 134,8  |
| 72                    | 93                    | 1              | 0,6             | 78,1            | 39                     | 23,1                     | 17 000                        | 26 000                           | 137                         | 577   | 1 276 | 392                          | 1 694 | 3 836  | 130,5                        | 219,2 | 297,3  |
| 72                    | 93                    | 1              | 0,6             | 78,1            | 38,5                   | 22,7                     | 16 000                        | 26 000                           | 177                         | 532   | 1 065 | 521                          | 1 616 | 3 335  | 89,6                         | 136,9 | 182,8  |
| 72                    | 93                    | 1              | 0,6             | 78,1            | 38,5                   | 21,7                     | 22 000                        | 32 000                           | 123                         | 369   | 737   | 357                          | 1 097 | 2 250  | 88,4                         | 132,9 | 174,9  |
| 72                    | 93                    | 1              | 0,6             | 79,7            | 19,3                   | 13,4                     | 19 000                        | 30 000                           | 67                          | 201   | 402   | 200                          | 630   | 1 312  | 47,4                         | 74,4  | 101,7  |
| 72                    | 93                    | 1              | 0,6             | 79,7            | 18,2                   | 12,7                     | 17 000                        | 26 000                           | 109                         | 328   | 656   | 315                          | 964   | 1 967  | 119                          | 177,2 | 231    |
| 72                    | 93                    | 1              | 0,6             | 79,7            | 18,2                   | 12,2                     | 22 000                        | 34 000                           | 74                          | 223   | 445   | 213                          | 647   | 1 313  | 117,5                        | 173,4 | 223,8  |
| 72                    | 93                    | 1              | 0,6             | 79,7            | 28                     | 12,2                     | 24 000                        | 38 000                           | 74                          | 223   | 445   | 213                          | 647   | 1 313  | 117,5                        | 173,4 | 223,8  |
| 75,5                  | 109,5                 | 1,5            | 1,5             | 88,2            | 68                     | 38,5                     | 12 000                        | 19 000                           | 386                         | 1 224 | 2 431 | 1 198                        | 4 118 | 8 752  | 78,9                         | 133,9 | 190,9  |
| 75,5                  | 109,5                 | 1,5            | 1,5             | 88,2            | 65                     | 36,5                     | 11 000                        | 18 000                           | 585                         | 1 977 | 4 100 | 1 709                        | 5 978 | 12 828 | 184,8                        | 294,5 | 399    |
| 75,5                  | 109,5                 | 1,5            | 1,5             | 88,2            | 68                     | 36,5                     | 15 000                        | 24 000                           | 205                         | 690   | 1 419 | 614                          | 2 192 | 4 757  | 68,2                         | 113,2 | 158,6  |
| 75,5                  | 109,5                 | 1,5            | 1,5             | 88,2            | 65                     | 35                       | 13 000                        | 20 000                           | 290                         | 1 071 | 2 286 | 834                          | 3 157 | 6 901  | 162,1                        | 260,7 | 333,1  |

# Spindle bearings

With large or small balls  
 Steel or ceramic balls  
 Steel or Cronidur rings  
 Open or sealed  
 Design DLR



**Dimension table** (continued) · Dimensions in mm

| Designation <sup>1)2)</sup> |                         |                        | Mass<br>m<br>≈ kg | Dimensions |     |    |      |                |                |                |                | Contact angle<br>α<br>° |
|-----------------------------|-------------------------|------------------------|-------------------|------------|-----|----|------|----------------|----------------|----------------|----------------|-------------------------|
| Series 719                  | Series 70               | Series 72              |                   | d          | D   | B  | r    | r <sub>1</sub> | B <sub>N</sub> | S <sub>N</sub> | S <sub>B</sub> |                         |
|                             |                         |                        |                   |            |     |    | min. |                |                |                |                |                         |
| <b>B71914-C-T-P4S</b>       | –                       | –                      | 0,34              | <b>70</b>  | 100 | 16 | 1    | 1              | –              | –              | –              | 15                      |
| <b>B71914-E-T-P4S</b>       | –                       | –                      | 0,339             | <b>70</b>  | 100 | 16 | 1    | 1              | –              | –              | –              | 25                      |
| <b>HCB71914-C-T-P4S</b>     | –                       | –                      | 0,281             | <b>70</b>  | 100 | 16 | 1    | 1              | 3,1            | 9,3            | 1,4            | 15                      |
| <b>HCB71914-E-T-P4S</b>     | –                       | –                      | 0,28              | <b>70</b>  | 100 | 16 | 1    | 1              | 3,1            | 9,3            | 1,4            | 25                      |
| <b>RS71914-D-T-P4S</b>      | –                       | –                      | 0,33              | <b>70</b>  | 100 | 16 | 1    | 1              | –              | –              | –              | 20                      |
| <b>HCRS71914-D-T-P4S</b>    | –                       | –                      | 0,28              | <b>70</b>  | 100 | 16 | 1    | 1              | 3,1            | 9,3            | 1,4            | 20                      |
| <b>HS71914-C-T-P4S</b>      | –                       | –                      | 0,354             | <b>70</b>  | 100 | 16 | 1    | –              | –              | –              | –              | 15                      |
| <b>HS71914-E-T-P4S</b>      | –                       | –                      | 0,353             | <b>70</b>  | 100 | 16 | 1    | –              | –              | –              | –              | 25                      |
| <b>HC71914-E-T-P4S</b>      | –                       | –                      | 0,379             | <b>70</b>  | 100 | 16 | 1    | –              | 3,1            | 9,3            | 1,4            | 25                      |
| <b>XC71914-E-T-P4S</b>      | –                       | –                      | 0,379             | <b>70</b>  | 100 | 16 | 1    | –              | 3,1            | 9,3            | 1,4            | 25                      |
| –                           | <b>B7014-C-T-P4S</b>    | –                      | 0,577             | <b>70</b>  | 110 | 20 | 1,1  | 1,1            | –              | –              | –              | 15                      |
| –                           | <b>B7014-E-T-P4S</b>    | –                      | 0,575             | <b>70</b>  | 110 | 20 | 1,1  | 1,1            | –              | –              | –              | 25                      |
| –                           | <b>HCB7014-C-T-P4S</b>  | –                      | 0,494             | <b>70</b>  | 110 | 20 | 1,1  | 1,1            | 4              | 11,6           | 1,4            | 15                      |
| –                           | <b>HCB7014-E-T-P4S</b>  | –                      | 0,492             | <b>70</b>  | 110 | 20 | 1,1  | 1,1            | 4              | 11,6           | 1,4            | 25                      |
| –                           | <b>RS7014-D-T-P4S</b>   | –                      | 0,59              | <b>70</b>  | 110 | 20 | 1,1  | 1,1            | –              | –              | –              | 20                      |
| –                           | <b>HCRS7014-D-T-P4S</b> | –                      | 0,59              | <b>70</b>  | 110 | 20 | 1,1  | 1,1            | 4              | 11,6           | 1,4            | 20                      |
| –                           | <b>HS7014-C-T-P4S</b>   | –                      | 0,644             | <b>70</b>  | 110 | 20 | 1,1  | –              | –              | –              | –              | 15                      |
| –                           | <b>HS7014-E-T-P4S</b>   | –                      | 0,643             | <b>70</b>  | 110 | 20 | 1,1  | –              | –              | –              | –              | 25                      |
| –                           | <b>HC7014-E-T-P4S</b>   | –                      | 0,67              | <b>70</b>  | 110 | 20 | 1,1  | –              | 4              | 11,6           | 1,4            | 25                      |
| –                           | <b>XC7014-E-T-P4S</b>   | –                      | 0,67              | <b>70</b>  | 110 | 20 | 1,1  | –              | 4              | 11,6           | 1,4            | 25                      |
| –                           | –                       | <b>B7214-C-T-P4S</b>   | 1,1               | <b>70</b>  | 125 | 24 | 1,5  | 1,5            | –              | –              | –              | 15                      |
| –                           | –                       | <b>B7214-E-T-P4S</b>   | 1,09              | <b>70</b>  | 125 | 24 | 1,5  | 1,5            | –              | –              | –              | 25                      |
| –                           | –                       | <b>HCB7214-C-T-P4S</b> | 0,954             | <b>70</b>  | 125 | 24 | 1,5  | 1,5            | –              | –              | –              | 15                      |
| –                           | –                       | <b>HCB7214-E-T-P4S</b> | 0,951             | <b>70</b>  | 125 | 24 | 1,5  | 1,5            | –              | –              | –              | 25                      |

<sup>1)</sup> Explanation of short designations, see page 130.

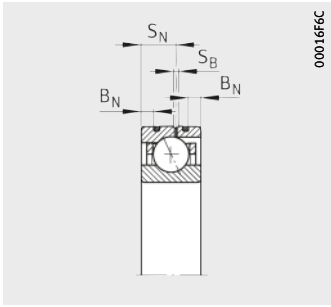
<sup>2)</sup> The bearings are also available with gap seals (type HSS, HCS, XCS or suffix 2RSD).  
 Ordering examples: B7014-C-2RSD-T-P4S-UL and HSS7014-E-T-P4S-UL.

<sup>3)</sup> The limiting speeds in the dimension tables are based on elastically preloaded single bearings.

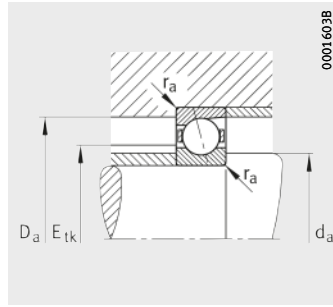
<sup>4)</sup> Explanation, see page 62.

<sup>5)</sup> Minimal quantity oil lubrication.

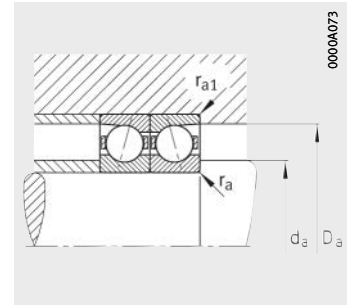
<sup>6)</sup> Ordering examples for Direct Lube design: HCB7014-EDLR-T-P4S-UL and HC7014-EDLR-T-P4S-UL.  
 DLR only up to bore code 22.



Design DLR<sup>6)</sup>



Mounting dimensions



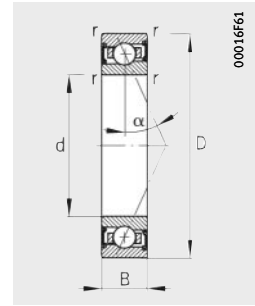
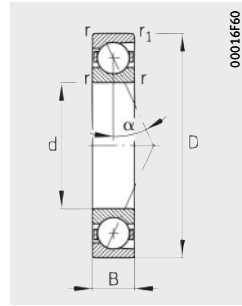
Mounting dimensions



| Mounting dimensions   |                       |                |                 |                 | Basic load ratings     |                          | Limiting speeds <sup>3)</sup> |                                  | Preload force <sup>4)</sup> |       |       | Lift-off force <sup>4)</sup> |       |        | Axial rigidity <sup>4)</sup> |       |       |
|-----------------------|-----------------------|----------------|-----------------|-----------------|------------------------|--------------------------|-------------------------------|----------------------------------|-----------------------------|-------|-------|------------------------------|-------|--------|------------------------------|-------|-------|
| d <sub>a</sub><br>h12 | D <sub>a</sub><br>H12 | r <sub>a</sub> | r <sub>a1</sub> | E <sub>tk</sub> | dyn.<br>C <sub>r</sub> | stat.<br>C <sub>0r</sub> | n <sub>G</sub> grease         | n <sub>G</sub> oil <sup>5)</sup> | L                           | M     | H     | L                            | M     | H      | L                            | M     | H     |
|                       |                       | max.           | nom.            | nom.            | kN                     | kN                       | min <sup>-1</sup>             | min <sup>-1</sup>                | N                           | N     | N     | N                            | N     | N      | N/μm                         | N/μm  | N/μm  |
| 76                    | 94,5                  | 0,6            | 0,6             | 82,2            | 34,5                   | 23                       | 14 000                        | 20 000                           | 170                         | 576   | 1 171 | 523                          | 1 912 | 4 155  | 66                           | 113,9 | 163,2 |
| 76                    | 94,5                  | 0,6            | 0,6             | 82,2            | 32,5                   | 21,8                     | 12 000                        | 19 000                           | 233                         | 886   | 1 902 | 677                          | 2 658 | 5 898  | 151                          | 249,4 | 340,8 |
| 76                    | 94,5                  | 0,6            | 0,6             | 82,2            | 34,5                   | 22                       | 19 000                        | 28 000                           | 83                          | 312   | 665   | 245                          | 980   | 2 200  | 55,5                         | 95,3  | 134,8 |
| 76                    | 94,5                  | 0,6            | 0,6             | 82,2            | 32,5                   | 20,8                     | 17 000                        | 26 000                           | 98                          | 459   | 1 040 | 281                          | 1 343 | 3 118  | 125,7                        | 218,1 | 298,1 |
| 76                    | 94,5                  | 0,6            | 0,6             | 82,2            | 32                     | 20,9                     | 16 000                        | 24 000                           | 156                         | 467   | 934   | 455                          | 1 406 | 2 893  | 99,2                         | 150,6 | 199,9 |
| 76                    | 94,5                  | 0,6            | 0,6             | 82,2            | 32                     | 20                       | 20 000                        | 32 000                           | 107                         | 322   | 644   | 310                          | 952   | 1 947  | 97,9                         | 146,5 | 173,8 |
| 76                    | 94,5                  | 0,6            | 0,6             | 82,3            | 17,8                   | 12,9                     | 19 000                        | 28 000                           | 61                          | 184   | 368   | 183                          | 576   | 1 198  | 47                           | 73,7  | 100,6 |
| 76                    | 94,5                  | 0,6            | 0,6             | 82,3            | 16,8                   | 12,2                     | 17 000                        | 26 000                           | 99                          | 298   | 597   | 287                          | 877   | 1 789  | 117,9                        | 175,5 | 228,5 |
| 76                    | 94,5                  | 0,6            | 0,6             | 82,3            | 16,8                   | 11,7                     | 22 000                        | 34 000                           | 69                          | 207   | 414   | 198                          | 602   | 1 221  | 117,4                        | 173,1 | 223,4 |
| 76                    | 94,5                  | 0,6            | 0,6             | 82,3            | 25,5                   | 11,7                     | 24 000                        | 36 000                           | 69                          | 207   | 414   | 198                          | 602   | 1 221  | 117,4                        | 173,1 | 223,4 |
| 77                    | 102                   | 1              | 0,6             | 85              | 50                     | 30,5                     | 13 000                        | 20 000                           | 276                         | 894   | 1 790 | 853                          | 2 995 | 6 414  | 73,5                         | 125,4 | 179,1 |
| 77                    | 102                   | 1              | 0,6             | 85              | 48                     | 29                       | 11 000                        | 18 000                           | 395                         | 1 388 | 2 915 | 1 149                        | 4 183 | 9 083  | 169,2                        | 272,8 | 370,6 |
| 77                    | 102                   | 1              | 0,6             | 85              | 50                     | 29,5                     | 18 000                        | 28 000                           | 139                         | 487   | 1 014 | 414                          | 1 538 | 3 380  | 62,3                         | 104,6 | 147   |
| 77                    | 102                   | 1              | 0,6             | 85              | 48                     | 28                       | 16 000                        | 24 000                           | 188                         | 749   | 1 633 | 540                          | 2 203 | 4 915  | 146,6                        | 241,7 | 326,3 |
| 77                    | 102                   | 1              | 0,6             | 85              | 49,5                   | 30                       | 15 000                        | 24 000                           | 218                         | 655   | 1 310 | 641                          | 1 988 | 4 104  | 96,8                         | 147,9 | 197,5 |
| 77                    | 102                   | 1              | 0,6             | 85              | 47,5                   | 28                       | 19 000                        | 30 000                           | 152                         | 457   | 915   | 443                          | 1 361 | 2 791  | 95,8                         | 144   | 189,6 |
| 77                    | 102                   | 1              | 0,6             | 86,7            | 25                     | 17,2                     | 18 000                        | 28 000                           | 87                          | 261   | 523   | 261                          | 820   | 1 706  | 52,2                         | 81,9  | 112   |
| 77                    | 102                   | 1              | 0,6             | 86,7            | 23,6                   | 16,3                     | 16 000                        | 24 000                           | 141                         | 423   | 845   | 406                          | 1 243 | 2 536  | 130,6                        | 194,4 | 253,4 |
| 77                    | 102                   | 1              | 0,6             | 86,7            | 23,6                   | 15,6                     | 20 000                        | 32 000                           | 98                          | 293   | 587   | 280                          | 853   | 1 731  | 130                          | 191,7 | 247,6 |
| 77                    | 102                   | 1              | 0,6             | 86,7            | 36                     | 15,6                     | 22 000                        | 34 000                           | 98                          | 293   | 587   | 280                          | 853   | 1 731  | 130                          | 191,7 | 247,6 |
| 80                    | 115                   | 1,5            | 1,5             | 92,7            | 71                     | 41,5                     | 11 000                        | 18 000                           | 399                         | 1 269 | 2 524 | 1 238                        | 4 260 | 9 062  | 83,1                         | 140,8 | 200,7 |
| 80                    | 115                   | 1,5            | 1,5             | 92,7            | 67                     | 39,5                     | 10 000                        | 17 000                           | 595                         | 2 017 | 4 189 | 1 736                        | 6 090 | 13 077 | 193,7                        | 308,6 | 417,8 |
| 80                    | 115                   | 1,5            | 1,5             | 92,7            | 71                     | 39,5                     | 14 000                        | 22 000                           | 211                         | 711   | 1 464 | 630                          | 2 253 | 4 894  | 71,6                         | 118,8 | 166,4 |
| 80                    | 115                   | 1,5            | 1,5             | 92,7            | 67                     | 38                       | 12 000                        | 19 000                           | 297                         | 1 103 | 2 359 | 854                          | 3 249 | 7 111  | 170,5                        | 274,5 | 350,3 |

# Spindle bearings

With large or small balls  
 Steel or ceramic balls  
 Steel or Cronidur rings  
 Open or sealed  
 Design DLR



**Dimension table** (continued) · Dimensions in mm

| Designation <sup>1)2)</sup> |                         |                        | Mass<br>m<br>≈ kg | Dimensions |     |    |     |                |                |                |                | Contact angle<br>α<br>° |
|-----------------------------|-------------------------|------------------------|-------------------|------------|-----|----|-----|----------------|----------------|----------------|----------------|-------------------------|
| Series 719                  | Series 70               | Series 72              |                   | d          | D   | B  | r   | r <sub>1</sub> | B <sub>N</sub> | S <sub>N</sub> | S <sub>B</sub> |                         |
| <b>B71915-C-T-P4S</b>       | –                       | –                      | 0,359             | <b>75</b>  | 105 | 16 | 1   | 1              | –              | –              | –              | 15                      |
| <b>B71915-E-T-P4S</b>       | –                       | –                      | 0,358             | <b>75</b>  | 105 | 16 | 1   | 1              | –              | –              | –              | 25                      |
| <b>HCB71915-C-T-P4S</b>     | –                       | –                      | 0,297             | <b>75</b>  | 105 | 16 | 1   | 1              | 3,1            | 9,3            | 1,4            | 15                      |
| <b>HCB71915-E-T-P4S</b>     | –                       | –                      | 0,296             | <b>75</b>  | 105 | 16 | 1   | 1              | 3,1            | 9,3            | 1,4            | 25                      |
| <b>RS71915-D-T-P4S</b>      | –                       | –                      | 0,355             | <b>75</b>  | 105 | 16 | 1   | 1              | –              | –              | –              | 20                      |
| <b>HCRS71915-D-T-P4S</b>    | –                       | –                      | 0,3               | <b>75</b>  | 105 | 16 | 1   | 1              | 3,1            | 9,3            | 1,4            | 20                      |
| <b>HS71915-C-T-P4S</b>      | –                       | –                      | 0,374             | <b>75</b>  | 105 | 16 | 1   | –              | –              | –              | –              | 15                      |
| <b>HS71915-E-T-P4S</b>      | –                       | –                      | 0,373             | <b>75</b>  | 105 | 16 | 1   | –              | –              | –              | –              | 25                      |
| <b>HC71915-E-T-P4S</b>      | –                       | –                      | 0,4               | <b>75</b>  | 105 | 16 | 1   | –              | 3,1            | 9,3            | 1,4            | 25                      |
| <b>XC71915-E-T-P4S</b>      | –                       | –                      | 0,4               | <b>75</b>  | 105 | 16 | 1   | –              | 3,1            | 9,3            | 1,4            | 25                      |
| –                           | <b>B7015-C-T-P4S</b>    | –                      | 0,608             | <b>75</b>  | 115 | 20 | 1,1 | 1,1            | –              | –              | –              | 15                      |
| –                           | <b>B7015-E-T-P4S</b>    | –                      | 0,606             | <b>75</b>  | 115 | 20 | 1,1 | 1,1            | –              | –              | –              | 25                      |
| –                           | <b>HCB7015-C-T-P4S</b>  | –                      | 0,521             | <b>75</b>  | 115 | 20 | 1,1 | 1,1            | 4              | 11,6           | 1,4            | 15                      |
| –                           | <b>HCB7015-E-T-P4S</b>  | –                      | 0,519             | <b>75</b>  | 115 | 20 | 1,1 | 1,1            | 4              | 11,6           | 1,4            | 25                      |
| –                           | <b>RS7015-D-T-P4S</b>   | –                      | 0,61              | <b>75</b>  | 115 | 20 | 1,1 | 1,1            | –              | –              | –              | 20                      |
| –                           | <b>HCRS7015-D-T-P4S</b> | –                      | 0,61              | <b>75</b>  | 115 | 20 | 1,1 | 1,1            | 4              | 11,6           | 1,4            | 20                      |
| –                           | <b>HS7015-C-T-P4S</b>   | –                      | 0,679             | <b>75</b>  | 115 | 20 | 1,1 | –              | –              | –              | –              | 15                      |
| –                           | <b>HS7015-E-T-P4S</b>   | –                      | 0,678             | <b>75</b>  | 115 | 20 | 1,1 | –              | –              | –              | –              | 25                      |
| –                           | <b>HC7015-E-T-P4S</b>   | –                      | 0,707             | <b>75</b>  | 115 | 20 | 1,1 | –              | 4              | 11,6           | 1,4            | 25                      |
| –                           | <b>XC7015-E-T-P4S</b>   | –                      | 0,707             | <b>75</b>  | 115 | 20 | 1,1 | –              | 4              | 11,6           | 1,4            | 25                      |
| –                           | –                       | <b>B7215-C-T-P4S</b>   | 1,2               | <b>75</b>  | 130 | 25 | 1,5 | 1,5            | –              | –              | –              | 15                      |
| –                           | –                       | <b>B7215-E-T-P4S</b>   | 1,2               | <b>75</b>  | 130 | 25 | 1,5 | 1,5            | –              | –              | –              | 25                      |
| –                           | –                       | <b>HCB7215-C-T-P4S</b> | 1,05              | <b>75</b>  | 130 | 25 | 1,5 | 1,5            | –              | –              | –              | 15                      |
| –                           | –                       | <b>HCB7215-E-T-P4S</b> | 1,04              | <b>75</b>  | 130 | 25 | 1,5 | 1,5            | –              | –              | –              | 25                      |

<sup>1)</sup> Explanation of short designations, see page 130.

<sup>2)</sup> The bearings are also available with gap seals (type HSS, HCS, XCS or suffix 2RSD).  
 Ordering examples: B7015-C-2RSD-T-P4S-UL and HSS7015-E-T-P4S-UL.

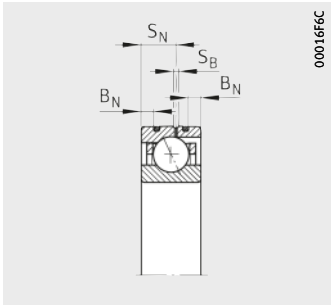
<sup>3)</sup> The limiting speeds in the dimension tables are based on elastically preloaded single bearings.

<sup>4)</sup> Explanation, see page 62.

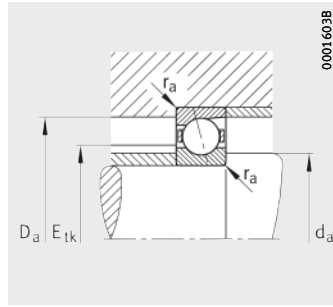
<sup>5)</sup> Minimal quantity oil lubrication.

<sup>6)</sup> Ordering examples for Direct Lube design: HCB7015-EDLR-T-P4S-UL and HC7015-EDLR-T-P4S-UL.  
 DLR only up to bore code 22.

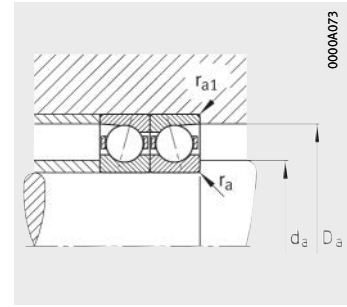




Design DLR<sup>6)</sup>



Mounting dimensions



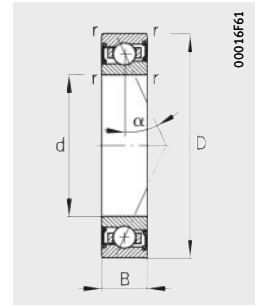
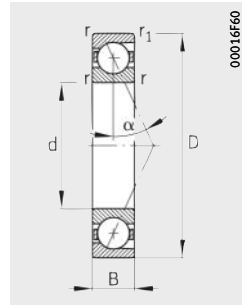
Mounting dimensions



| Mounting dimensions   |                       |                |                 |                 | Basic load ratings     |                          | Limiting speeds <sup>3)</sup> |                                  | Preload force <sup>4)</sup> |       |       | Lift-off force <sup>4)</sup> |       |        | Axial rigidity <sup>4)</sup> |       |       |
|-----------------------|-----------------------|----------------|-----------------|-----------------|------------------------|--------------------------|-------------------------------|----------------------------------|-----------------------------|-------|-------|------------------------------|-------|--------|------------------------------|-------|-------|
| d <sub>a</sub><br>h12 | D <sub>a</sub><br>H12 | r <sub>a</sub> | r <sub>a1</sub> | E <sub>tk</sub> | dyn.<br>C <sub>r</sub> | stat.<br>C <sub>0r</sub> | n <sub>G</sub> grease         | n <sub>G</sub> oil <sup>5)</sup> | F <sub>v</sub>              |       |       | K <sub>aE</sub>              |       |        | C <sub>a</sub>               |       |       |
|                       |                       | max.           | nom.            | nom.            | kN                     | kN                       | min <sup>-1</sup>             | min <sup>-1</sup>                | L                           | M     | H     | L                            | M     | H      | L                            | M     | H     |
|                       |                       |                |                 |                 |                        |                          |                               |                                  | N                           | N     | N     | N                            | N     | N      | N/μm                         | N/μm  | N/μm  |
| 81                    | 99,5                  | 0,6            | 0,6             | 87,2            | 35                     | 24,2                     | 13 000                        | 20 000                           | 172                         | 584   | 1 189 | 527                          | 1 933 | 4 206  | 68                           | 117,2 | 167,9 |
| 81                    | 99,5                  | 0,6            | 0,6             | 87,2            | 33                     | 22,9                     | 11 000                        | 18 000                           | 235                         | 897   | 1 928 | 682                          | 2 688 | 5 970  | 155,6                        | 257,1 | 351,3 |
| 81                    | 99,5                  | 0,6            | 0,6             | 87,2            | 35                     | 23,1                     | 18 000                        | 28 000                           | 83                          | 317   | 676   | 247                          | 991   | 2 229  | 57,1                         | 98,2  | 138,8 |
| 81                    | 99,5                  | 0,6            | 0,6             | 87,2            | 33                     | 21,9                     | 16 000                        | 24 000                           | 95                          | 454   | 1 034 | 273                          | 1 328 | 3 094  | 127,9                        | 223,2 | 305,2 |
| 81                    | 99,5                  | 0,6            | 0,6             | 87,2            | 33                     | 22                       | 15 000                        | 24 000                           | 156                         | 467   | 934   | 454                          | 1 404 | 2 888  | 101,9                        | 154,5 | 204,8 |
| 81                    | 99,5                  | 0,6            | 0,6             | 87,2            | 33                     | 21                       | 19 000                        | 30 000                           | 109                         | 328   | 655   | 316                          | 968   | 1 980  | 101,3                        | 151,5 | 179,3 |
| 81                    | 99,5                  | 0,6            | 0,6             | 87,3            | 18,3                   | 13,8                     | 18 000                        | 28 000                           | 64                          | 191   | 382   | 190                          | 597   | 1 242  | 49,5                         | 77,5  | 105,7 |
| 81                    | 99,5                  | 0,6            | 0,6             | 87,3            | 17,2                   | 13                       | 16 000                        | 24 000                           | 101                         | 304   | 607   | 292                          | 891   | 1 817  | 123,4                        | 183,4 | 238,7 |
| 81                    | 99,5                  | 0,6            | 0,6             | 87,3            | 17,2                   | 12,5                     | 20 000                        | 32 000                           | 70                          | 210   | 421   | 201                          | 611   | 1 240  | 122,8                        | 181   | 233,4 |
| 81                    | 99,5                  | 0,6            | 0,6             | 87,3            | 26,5                   | 12,5                     | 22 000                        | 34 000                           | 70                          | 210   | 421   | 201                          | 611   | 1 240  | 122,8                        | 181   | 233,4 |
| 82                    | 107                   | 1              | 0,6             | 90              | 52                     | 32,5                     | 12 000                        | 19 000                           | 280                         | 911   | 1 827 | 865                          | 3 043 | 6 525  | 76,3                         | 130,1 | 185,7 |
| 82                    | 107                   | 1              | 0,6             | 90              | 49,5                   | 31                       | 11 000                        | 17 000                           | 405                         | 1 430 | 3 005 | 1 180                        | 4 305 | 9 353  | 176,8                        | 285,2 | 387,2 |
| 82                    | 107                   | 1              | 0,6             | 90              | 52                     | 31,5                     | 17 000                        | 26 000                           | 145                         | 508   | 1 059 | 431                          | 1 603 | 3 524  | 65,4                         | 109,8 | 154,3 |
| 82                    | 107                   | 1              | 0,6             | 90              | 49,5                   | 29,5                     | 15 000                        | 24 000                           | 192                         | 769   | 1 679 | 551                          | 2 260 | 5 050  | 153                          | 252,5 | 340,9 |
| 82                    | 107                   | 1              | 0,6             | 90              | 49                     | 29,5                     | 14 000                        | 22 000                           | 228                         | 683   | 1 365 | 667                          | 2 070 | 4 272  | 101,7                        | 155,3 | 207,3 |
| 82                    | 107                   | 1              | 0,6             | 90              | 49                     | 28,5                     | 18 000                        | 28 000                           | 157                         | 471   | 942   | 456                          | 1 401 | 2 872  | 100,2                        | 150,6 | 198,1 |
| 82                    | 107                   | 1              | 0,6             | 91,7            | 25,5                   | 17,9                     | 17 000                        | 26 000                           | 89                          | 266   | 533   | 265                          | 835   | 1 737  | 53,7                         | 84,3  | 115,1 |
| 82                    | 107                   | 1              | 0,6             | 91,7            | 23,9                   | 17                       | 15 000                        | 24 000                           | 144                         | 431   | 863   | 415                          | 1 268 | 2 587  | 134,5                        | 200,3 | 261   |
| 82                    | 107                   | 1              | 0,6             | 91,7            | 23,9                   | 16,2                     | 19 000                        | 30 000                           | 99                          | 298   | 597   | 285                          | 868   | 1 761  | 133,8                        | 197,3 | 254,7 |
| 82                    | 107                   | 1              | 0,6             | 91,7            | 36,5                   | 16,2                     | 22 000                        | 32 000                           | 99                          | 298   | 597   | 285                          | 868   | 1 761  | 133,8                        | 197,3 | 254,7 |
| 85                    | 120                   | 1,5            | 1,5             | 97,7            | 73                     | 44,5                     | 11 000                        | 18 000                           | 413                         | 1 314 | 2 617 | 1 278                        | 4 401 | 9 371  | 87,2                         | 147,8 | 210,4 |
| 85                    | 120                   | 1,5            | 1,5             | 97,7            | 70                     | 42,5                     | 9 500                         | 16 000                           | 615                         | 2 091 | 4 345 | 1 794                        | 6 306 | 13 546 | 203,8                        | 324,7 | 439,4 |
| 85                    | 120                   | 1,5            | 1,5             | 97,7            | 73                     | 42,5                     | 14 000                        | 22 000                           | 219                         | 740   | 1 524 | 653                          | 2 341 | 5 087  | 75,4                         | 125,1 | 175,1 |
| 85                    | 120                   | 1,5            | 1,5             | 97,7            | 70                     | 40,5                     | 12 000                        | 19 000                           | 308                         | 1 149 | 2 459 | 887                          | 3 383 | 7 409  | 179,7                        | 289,5 | 369,2 |

# Spindle bearings

With large or small balls  
 Steel or ceramic balls  
 Steel or Cronidur rings  
 Open or sealed  
 Design DLR



**Dimension table** (continued) · Dimensions in mm

| Designation <sup>1)2)</sup> |                         |                        | Mass<br>m<br>≈ kg | Dimensions |     |    |      |                |                |                |                | Contact angle<br>α<br>° |
|-----------------------------|-------------------------|------------------------|-------------------|------------|-----|----|------|----------------|----------------|----------------|----------------|-------------------------|
| Series 719                  | Series 70               | Series 72              |                   | d          | D   | B  | r    | r <sub>1</sub> | B <sub>N</sub> | S <sub>N</sub> | S <sub>B</sub> |                         |
|                             |                         |                        |                   |            |     |    |      |                |                |                |                |                         |
|                             |                         |                        |                   |            |     |    | min. |                |                |                |                |                         |
| <b>B71916-C-T-P4S</b>       | –                       | –                      | 0,376             | <b>80</b>  | 110 | 16 | 1    | 1              | –              | –              | –              | 15                      |
| <b>B71916-E-T-P4S</b>       | –                       | –                      | 0,375             | <b>80</b>  | 110 | 16 | 1    | 1              | –              | –              | –              | 25                      |
| <b>HCB71916-C-T-P4S</b>     | –                       | –                      | 0,312             | <b>80</b>  | 110 | 16 | 1    | 1              | 3,1            | 9,3            | 1,4            | 15                      |
| <b>HCB71916-E-T-P4S</b>     | –                       | –                      | 0,311             | <b>80</b>  | 110 | 16 | 1    | 1              | 3,1            | 9,3            | 1,4            | 25                      |
| <b>RS71916-D-T-P4S</b>      | –                       | –                      | 0,365             | <b>80</b>  | 110 | 16 | 1    | 1              | –              | –              | –              | 20                      |
| <b>HCRS71916-D-T-P4S</b>    | –                       | –                      | 0,32              | <b>80</b>  | 110 | 16 | 1    | 1              | 3,1            | 9,3            | 1,4            | 20                      |
| <b>HS71916-C-T-P4S</b>      | –                       | –                      | 0,379             | <b>80</b>  | 110 | 16 | 1    | –              | –              | –              | –              | 15                      |
| <b>HS71916-E-T-P4S</b>      | –                       | –                      | 0,379             | <b>80</b>  | 110 | 16 | 1    | –              | –              | –              | –              | 25                      |
| <b>HC71916-E-T-P4S</b>      | –                       | –                      | 0,41              | <b>80</b>  | 110 | 16 | 1    | –              | 3,1            | 9,3            | 1,4            | 25                      |
| <b>XC71916-E-T-P4S</b>      | –                       | –                      | 0,41              | <b>80</b>  | 110 | 16 | 1    | –              | 3,1            | 9,3            | 1,4            | 25                      |
| –                           | <b>B7016-C-T-P4S</b>    | –                      | 0,836             | <b>80</b>  | 125 | 22 | 1,1  | 1,1            | –              | –              | –              | 15                      |
| –                           | <b>B7016-E-T-P4S</b>    | –                      | 0,833             | <b>80</b>  | 125 | 22 | 1,1  | 1,1            | –              | –              | –              | 25                      |
| –                           | <b>HCB7016-C-T-P4S</b>  | –                      | 0,699             | <b>80</b>  | 125 | 22 | 1,1  | 1,1            | 4,7            | 12,2           | 2,2            | 15                      |
| –                           | <b>HCB7016-E-T-P4S</b>  | –                      | 0,696             | <b>80</b>  | 125 | 22 | 1,1  | 1,1            | 4,7            | 12,2           | 2,2            | 25                      |
| –                           | <b>RS7016-D-T-P4S</b>   | –                      | 0,84              | <b>80</b>  | 125 | 22 | 1,1  | 1,1            | –              | –              | –              | 20                      |
| –                           | <b>HCRS7016-D-T-P4S</b> | –                      | 0,84              | <b>80</b>  | 125 | 22 | 1,1  | 1,1            | 4,7            | 12,2           | 2,2            | 20                      |
| –                           | <b>HS7016-C-T-P4S</b>   | –                      | 0,927             | <b>80</b>  | 125 | 22 | 1,1  | –              | –              | –              | –              | 15                      |
| –                           | <b>HS7016-E-T-P4S</b>   | –                      | 0,925             | <b>80</b>  | 125 | 22 | 1,1  | –              | –              | –              | –              | 25                      |
| –                           | <b>HC7016-E-T-P4S</b>   | –                      | 0,943             | <b>80</b>  | 125 | 22 | 1,1  | –              | 4,7            | 12,2           | 2,2            | 25                      |
| –                           | <b>XC7016-E-T-P4S</b>   | –                      | 0,943             | <b>80</b>  | 125 | 22 | 1,1  | –              | 4,7            | 12,2           | 2,2            | 25                      |
| –                           | –                       | <b>B7216-C-T-P4S</b>   | 1,43              | <b>80</b>  | 140 | 26 | 2    | 2              | –              | –              | –              | 15                      |
| –                           | –                       | <b>B7216-E-T-P4S</b>   | 1,42              | <b>80</b>  | 140 | 26 | 2    | 2              | –              | –              | –              | 25                      |
| –                           | –                       | <b>HCB7216-C-T-P4S</b> | 1,18              | <b>80</b>  | 140 | 26 | 2    | 2              | –              | –              | –              | 15                      |
| –                           | –                       | <b>HCB7216-E-T-P4S</b> | 1,18              | <b>80</b>  | 140 | 26 | 2    | 2              | –              | –              | –              | 25                      |

<sup>1)</sup> Explanation of short designations, see page 130.

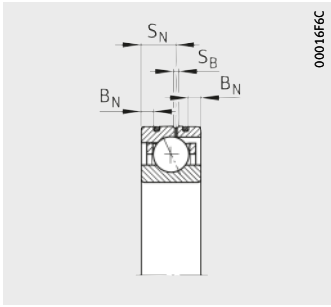
<sup>2)</sup> The bearings are also available with gap seals (type HSS, HCS, XCS or suffix 2RSD).  
 Ordering examples: B7016-C-2RSD-T-P4S-UL and HSS7016-E-T-P4S-UL.

<sup>3)</sup> The limiting speeds in the dimension tables are based on elastically preloaded single bearings.

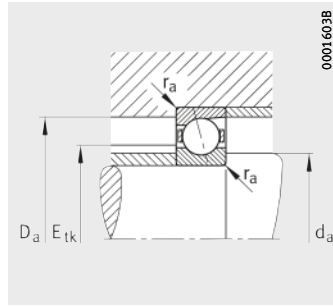
<sup>4)</sup> Explanation, see page 62.

<sup>5)</sup> Minimal quantity oil lubrication.

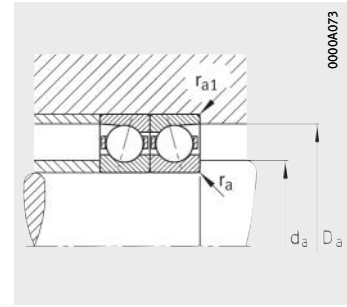
<sup>6)</sup> Ordering examples for Direct Lube design: HCB7016-EDLR-T-P4S-UL and HC7016-EDLR-T-P4S-UL.  
 DLR only up to bore code 22.



Design DLR<sup>6)</sup>



Mounting dimensions



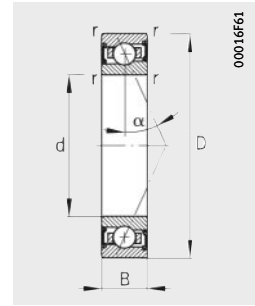
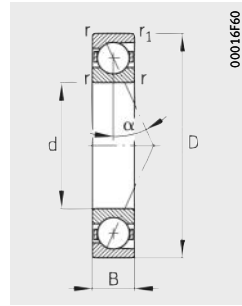
Mounting dimensions



| Mounting dimensions   |                       |                |                 |                 | Basic load ratings     |                          | Limiting speeds <sup>3)</sup> |                                  | Preload force <sup>4)</sup><br>F <sub>V</sub> |       |       | Lift-off force <sup>4)</sup><br>K <sub>aE</sub> |       |        | Axial rigidity <sup>4)</sup><br>c <sub>a</sub> |       |        |
|-----------------------|-----------------------|----------------|-----------------|-----------------|------------------------|--------------------------|-------------------------------|----------------------------------|---|-------|-------|---|-------|--------|--|-------|--------|
| d <sub>a</sub><br>h12 | D <sub>a</sub><br>H12 | r <sub>a</sub> | r <sub>a1</sub> | E <sub>tk</sub> | dyn.<br>C <sub>r</sub> | stat.<br>C <sub>0r</sub> | n <sub>G</sub> grease         | n <sub>G</sub> oil <sup>5)</sup> | L   | M     | H     | L   | M     | H      | L  | M     | H      |
|                       |                       | max.           |                 | nom.            | kN                     | kN                       | min <sup>-1</sup>             | min <sup>-1</sup>                | N   | N     | N     | N   | N     | N      | N/μm   | N/μm  | N/μm   |
| 86                    | 104                   | 0,6            | 0,6             | 92,2            | 35,5                   | 25,5                     | 12 000                        | 19 000                           | 174   | 591   | 1 206 | 532   | 1 954 | 4 257  | 69,9   | 120,5 | 172,5  |
| 86                    | 104                   | 0,6            | 0,6             | 92,2            | 33,5                   | 24                       | 11 000                        | 17 000                           | 237   | 908   | 1 955 | 686   | 2 718 | 6 043  | 160,1  | 264,8 | 361,7  |
| 86                    | 104                   | 0,6            | 0,6             | 92,2            | 35,5                   | 24,3                     | 17 000                        | 26 000                           | 84  | 321   | 686   | 249   | 1 004 | 2 259  | 58,8   | 101,1 | 142,9  |
| 86                    | 104                   | 0,6            | 0,6             | 92,2            | 33,5                   | 23                       | 15 000                        | 24 000                           | 95  | 459   | 1 049 | 273   | 1 344 | 3 137  | 131,5  | 230,1 | 314,7  |
| 86                    | 104                   | 0,6            | 0,6             | 92,2            | 33,5                   | 23,1                     | 14 000                        | 22 000                           | 160   | 481   | 963   | 468   | 1 446 | 2 975  | 105,8  | 160,3 | 212,4  |
| 86                    | 104                   | 0,6            | 0,6             | 92,2            | 33,5                   | 22,1                     | 18 000                        | 28 000                           | 111   | 333   | 667   | 321   | 985   | 2 013  | 104,6  | 156,4 | 184,8  |
| 86                    | 104                   | 0,6            | 0,6             | 92,15           | 20,3                   | 15,5                     | 17 000                        | 26 000                           | 71  | 213   | 426   | 212   | 666   | 1 385  | 52,3   | 81,9  | 111,7  |
| 86                    | 104                   | 0,6            | 0,6             | 92,15           | 19,2                   | 14,6                     | 15 000                        | 24 000                           | 113   | 338   | 676   | 325   | 992   | 2 023  | 130,4  | 193,9 | 252,3  |
| 86                    | 104                   | 0,6            | 0,6             | 92,15           | 19,2                   | 14                       | 19 000                        | 30 000                           | 79  | 236   | 473   | 226   | 686   | 1 392  | 130,2  | 191,9 | 247,5  |
| 86                    | 104                   | 0,6            | 0,6             | 92,15           | 29,5                   | 14                       | 22 000                        | 32 000                           | 79  | 236   | 473   | 226   | 686   | 1 392  | 130,2  | 191,9 | 247,5  |
| 88                    | 117                   | 1              | 0,6             | 96,8            | 64                     | 41                       | 11 000                        | 17 000                           | 354   | 1 138 | 2 277 | 1 091   | 3 797 | 8 119  | 85,7   | 145,4 | 207,21 |
| 88                    | 117                   | 1              | 0,6             | 96,8            | 61                     | 39                       | 10 000                        | 15 000                           | 525   | 1 816 | 3 796 | 1 528   | 5 469 | 11 813 | 200,6  | 321,3 | 435,3  |
| 88                    | 117                   | 1              | 0,6             | 96,8            | 64                     | 39                       | 15 000                        | 24 000                           | 186   | 640   | 1 327 | 554   | 2 020 | 4 415  | 74   | 123,3 | 172,8  |
| 88                    | 117                   | 1              | 0,6             | 96,8            | 61                     | 37,5                     | 14 000                        | 22 000                           | 252   | 977   | 2 113 | 726   | 2 872 | 6 354  | 174,5  | 284,4 | 382,6  |
| 88                    | 117                   | 1              | 0,6             | 96,8            | 61                     | 37,5                     | 13 000                        | 20 000                           | 282   | 846   | 1 693 | 827   | 2 565 | 5 292  | 113,5  | 173,2 | 231,1  |
| 88                    | 117                   | 1              | 0,6             | 96,8            | 61                     | 36                       | 17 000                        | 26 000                           | 196   | 587   | 1 174 | 568   | 1 745 | 3 577  | 112,1  | 168,4 | 221,5  |
| 88                    | 117                   | 1              | 0,6             | 98,9            | 30,5                   | 21,8                     | 15 000                        | 24 000                           | 106   | 317   | 633   | 315   | 991   | 2 063  | 58,7   | 92    | 125,6  |
| 88                    | 117                   | 1              | 0,6             | 98,9            | 28,5                   | 20,6                     | 14 000                        | 22 000                           | 173   | 518   | 1 035 | 497   | 1 521 | 3 103  | 147,5  | 219,6 | 286,1  |
| 88                    | 117                   | 1              | 0,6             | 98,9            | 28,5                   | 19,7                     | 18 000                        | 28 000                           | 117   | 352   | 704   | 336   | 1 023 | 2 075  | 145,8  | 215   | 277,5  |
| 88                    | 117                   | 1              | 0,6             | 98,9            | 44                     | 19,7                     | 20 000                        | 30 000                           | 117   | 352   | 704   | 336   | 1 023 | 2 075  | 145,8  | 215   | 277,5  |
| 91                    | 129                   | 2              | 2               | 104,3           | 94                     | 55                       | 10 000                        | 17 000                           | 549   | 1 721 | 3 412 | 1 701   | 5 781 | 12 250 | 94,1   | 158,8 | 225,9  |
| 91                    | 129                   | 2              | 2               | 104,3           | 89                     | 52                       | 9 000                         | 15 000                           | 833   | 2 764 | 5 699 | 2 433   | 8 347 | 17 799 | 220,9  | 349,3 | 471,6  |
| 91                    | 129                   | 2              | 2               | 104,3           | 94                     | 52                       | 12 000                        | 19 000                           | 293   | 968   | 1 979 | 876   | 3 068 | 6 618  | 81,5   | 134,2 | 187,4  |
| 91                    | 129                   | 2              | 2               | 104,3           | 89                     | 50                       | 11 000                        | 18 000                           | 428   | 1 527 | 3 225 | 1 232   | 4 498 | 9 728  | 196,3  | 311,7 | 399,6  |

# Spindle bearings

With large or small balls  
 Steel or ceramic balls  
 Steel or Cronidur rings  
 Open or sealed  
 Design DLR



**Dimension table** (continued) · Dimensions in mm

| Designation <sup>1)</sup> |                         |                        | Mass<br>m<br>≈ kg | Dimensions |     |    |      |                |                |                |                | Contact angle<br>α<br>° |  |
|---------------------------|-------------------------|------------------------|-------------------|------------|-----|----|------|----------------|----------------|----------------|----------------|-------------------------|--|
| Series 719 <sup>4)</sup>  | Series 70 <sup>4)</sup> | Series 72              |                   | d          | D   | B  | r    | r <sub>1</sub> | B <sub>N</sub> | S <sub>N</sub> | S <sub>B</sub> |                         |  |
|                           |                         |                        |                   |            |     |    |      |                |                |                |                |                         |  |
|                           |                         |                        |                   |            |     |    | min. |                |                |                |                |                         |  |
| <b>B71917-C-T-P4S</b>     | –                       | –                      | 0,533             | <b>85</b>  | 120 | 18 | 1,1  | 1,1            | –              | –              | –              | 15                      |  |
| <b>B71917-E-T-P4S</b>     | –                       | –                      | 0,532             | <b>85</b>  | 120 | 18 | 1,1  | 1,1            | –              | –              | –              | 25                      |  |
| <b>HCB71917-C-T-P4S</b>   | –                       | –                      | 0,441             | <b>85</b>  | 120 | 18 | 1,1  | 1,1            | 4              | 10,4           | 2,2            | 15                      |  |
| <b>HCB71917-E-T-P4S</b>   | –                       | –                      | 0,44              | <b>85</b>  | 120 | 18 | 1,1  | 1,1            | 4              | 10,4           | 2,2            | 25                      |  |
| <b>RS71917-D-T-P4S</b>    | –                       | –                      | 0,53              | <b>85</b>  | 120 | 18 | 1,1  | 1,1            | –              | –              | –              | 20                      |  |
| <b>HCRS71917-D-T-P4S</b>  | –                       | –                      | 0,45              | <b>85</b>  | 120 | 18 | 1,1  | 1,1            | 4              | 10,4           | 2,2            | 20                      |  |
| <b>HS71917-C-T-P4S</b>    | –                       | –                      | 0,572             | <b>85</b>  | 120 | 18 | 1,1  | –              | –              | –              | –              | 15                      |  |
| <b>HS71917-E-T-P4S</b>    | –                       | –                      | 0,571             | <b>85</b>  | 120 | 18 | 1,1  | –              | –              | –              | –              | 25                      |  |
| <b>HC71917-E-T-P4S</b>    | –                       | –                      | 0,604             | <b>85</b>  | 120 | 18 | 1,1  | –              | 4              | 10,4           | 2,2            | 25                      |  |
| <b>XC71917-E-T-P4S</b>    | –                       | –                      | 0,604             | <b>85</b>  | 120 | 18 | 1,1  | –              | 4              | 10,4           | 2,2            | 25                      |  |
| –                         | <b>B7017-C-T-P4S</b>    | –                      | 0,878             | <b>85</b>  | 130 | 22 | 1,1  | 1,1            | –              | –              | –              | 15                      |  |
| –                         | <b>B7017-E-T-P4S</b>    | –                      | 0,875             | <b>85</b>  | 130 | 22 | 1,1  | 1,1            | –              | –              | –              | 25                      |  |
| –                         | <b>HCB7017-C-T-P4S</b>  | –                      | 0,734             | <b>85</b>  | 130 | 22 | 1,1  | 1,1            | 4,7            | 12,2           | 2,2            | 15                      |  |
| –                         | <b>HCB7017-E-T-P4S</b>  | –                      | 0,731             | <b>85</b>  | 130 | 22 | 1,1  | 1,1            | 4,7            | 12,2           | 2,2            | 25                      |  |
| –                         | <b>RS7017-D-T-P4S</b>   | –                      | 0,87              | <b>85</b>  | 130 | 22 | 1,1  | 1,1            | –              | –              | –              | 20                      |  |
| –                         | <b>HCRS7017-D-T-P4S</b> | –                      | 0,87              | <b>85</b>  | 130 | 22 | 1,1  | 1,1            | 4,7            | 12,2           | 2,2            | 20                      |  |
| –                         | <b>HS7017-C-T-P4S</b>   | –                      | 0,97              | <b>85</b>  | 130 | 22 | 1,1  | –              | –              | –              | –              | 15                      |  |
| –                         | <b>HS7017-E-T-P4S</b>   | –                      | 0,969             | <b>85</b>  | 130 | 22 | 1,1  | –              | –              | –              | –              | 25                      |  |
| –                         | <b>HC7017-E-T-P4S</b>   | –                      | 0,989             | <b>85</b>  | 130 | 22 | 1,1  | –              | 4,7            | 12,2           | 2,2            | 25                      |  |
| –                         | <b>XC7017-E-T-P4S</b>   | –                      | 0,989             | <b>85</b>  | 130 | 22 | 1,1  | –              | 4,7            | 12,2           | 2,2            | 25                      |  |
| –                         | –                       | <b>B7217-C-T-P4S</b>   | 1,82              | <b>85</b>  | 150 | 28 | 2    | 2              | –              | –              | –              | 15                      |  |
| –                         | –                       | <b>B7217-E-T-P4S</b>   | 1,81              | <b>85</b>  | 150 | 28 | 2    | 2              | –              | –              | –              | 25                      |  |
| –                         | –                       | <b>HCB7217-C-T-P4S</b> | 1,55              | <b>85</b>  | 150 | 28 | 2    | 2              | –              | –              | –              | 15                      |  |
| –                         | –                       | <b>HCB7217-E-T-P4S</b> | 1,55              | <b>85</b>  | 150 | 28 | 2    | 2              | –              | –              | –              | 25                      |  |

<sup>1)</sup> Explanation of short designations, see page 130.

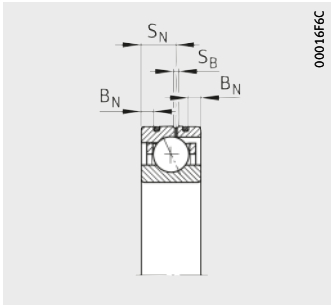
<sup>2)</sup> The limiting speeds in the dimension tables are based on elastically preloaded single bearings.

<sup>3)</sup> Explanation, see page 62.

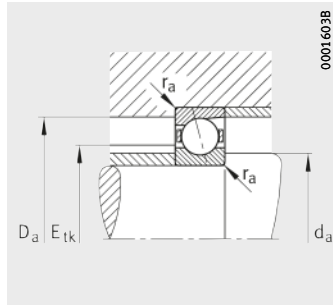
<sup>4)</sup> The bearings are also available with gap seals (type HSS, HCS, XCS or suffix 2RSD).  
 Ordering examples: B7017-C-2RSD-T-P4S-UL and HSS7017-E-T-P4S-UL.

<sup>5)</sup> Minimal quantity oil lubrication.

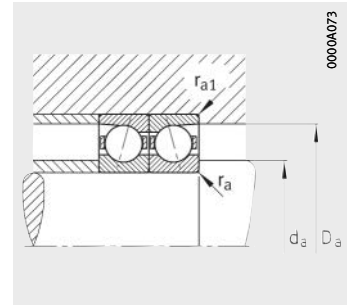
<sup>6)</sup> Ordering examples for Direct Lube design: HCB7017-EDLR-T-P4S-UL and HC7017-EDLR-T-P4S-UL.  
 DLR only up to bore code 22.



Design DLR<sup>6)</sup>



Mounting dimensions



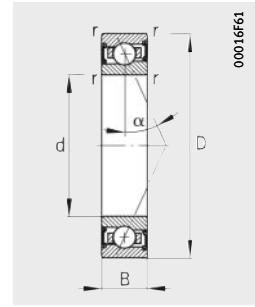
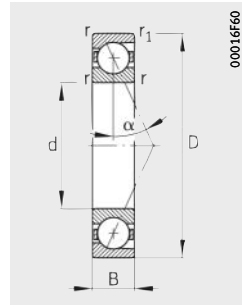
Mounting dimensions



| Mounting dimensions   |                       |                        |                         |                         | Basic load ratings           |                                | Limiting speeds <sup>2)</sup>              |   | Preload force <sup>3)</sup><br>F <sub>v</sub> |        |        | Lift-off force <sup>3)</sup><br>K <sub>aE</sub> |        |        | Axial rigidity <sup>3)</sup><br>c <sub>a</sub> |           |           |
|-----------------------|-----------------------|------------------------|-------------------------|-------------------------|------------------------------|--------------------------------|--|---|---|--------|--------|---|--------|--------|--|-----------|-----------|
| d <sub>a</sub><br>h12 | D <sub>a</sub><br>H12 | r <sub>a</sub><br>max. | r <sub>a1</sub><br>max. | E <sub>tk</sub><br>nom. | dyn.<br>C <sub>r</sub><br>kN | stat.<br>C <sub>0r</sub><br>kN | n <sub>G</sub> grease<br>min <sup>-1</sup> | n <sub>G</sub> oil <sup>5)</sup><br>min <sup>-1</sup> | L<br>N  | M<br>N | H<br>N | L<br>N  | M<br>N | H<br>N | L<br>N/μm                                      | M<br>N/μm | H<br>N/μm |
| 92                    | 114                   | 0,6                    | 0,6                     | 99,2                    | 47                           | 33,5                           | 11 000                                     | 17 000  | 237   | 788    | 1 597  | 726   | 2 609  | 5 644  | 79,7   | 136,3     | 194,5     |
| 92                    | 114                   | 0,6                    | 0,6                     | 99,2                    | 44,5                         | 31,5                           | 10 000                                     | 15 000  | 333   | 1 226  | 2 609  | 968   | 3 675  | 8 074  | 184,3  | 300,5     | 408,8     |
| 92                    | 114                   | 0,6                    | 0,6                     | 99,2                    | 47                           | 32                             | 15 000                                     | 24 000  | 117   | 428    | 906    | 346   | 1 341  | 2 985  | 67,4   | 114,3     | 160,8     |
| 92                    | 114                   | 0,6                    | 0,6                     | 99,2                    | 44,5                         | 30                             | 14 000                                     | 22 000  | 143   | 627    | 1 403  | 409   | 1 837  | 4 197  | 154,3  | 261,9     | 355,6     |
| 92                    | 114                   | 0,6                    | 0,6                     | 99,2                    | 43,5                         | 29,5                           | 13 000                                     | 20 000  | 211   | 632    | 1 265  | 615   | 1 900  | 3 908  | 118,7  | 179,9     | 238,4     |
| 92                    | 114                   | 0,6                    | 0,6                     | 99,2                    | 43,5                         | 28,5                           | 17 000                                     | 26 000  | 144   | 431    | 862    | 415   | 1 273  | 2 602  | 116,8  | 174,5     | 209,2     |
| 92                    | 114                   | 0,6                    | 0,6                     | 99,7                    | 21,2                         | 17                             | 15 000                                     | 24 000  | 74  | 221    | 442    | 220   | 689    | 1 433  | 55,9   | 87,4      | 118,9     |
| 92                    | 114                   | 0,6                    | 0,6                     | 99,7                    | 20                           | 16                             | 14 000                                     | 22 000  | 117   | 352    | 704    | 338   | 1 032  | 2 102  | 139,7  | 207,6     | 269,9     |
| 92                    | 114                   | 0,6                    | 0,6                     | 99,7                    | 20                           | 15,3                           | 18 000                                     | 28 000  | 82  | 247    | 493    | 236   | 716    | 1 452  | 139,7  | 205,7     | 265,2     |
| 92                    | 114                   | 0,6                    | 0,6                     | 99,7                    | 30,5                         | 15,3                           | 20 000                                     | 30 000  | 82  | 247    | 493    | 236   | 716    | 1 452  | 139,7  | 205,7     | 265,2     |
| 93                    | 122                   | 1                      | 0,6                     | 101,8                   | 66                           | 43,5                           | 11 000                                     | 16 000  | 367   | 1 183  | 2 368  | 1 132   | 3 942  | 8 434  | 89,7   | 152,1     | 216,72    |
| 93                    | 122                   | 1                      | 0,6                     | 101,8                   | 63                           | 41,5                           | 9 500                                      | 15 000  | 540   | 1 874  | 3 919  | 1 573   | 5 639  | 12 184 | 209,4  | 335,5     | 454,4     |
| 93                    | 122                   | 1                      | 0,6                     | 101,8                   | 66                           | 41,5                           | 15 000                                     | 22 000  | 189   | 653    | 1 356  | 562   | 2 058  | 4 501  | 76,9   | 128,1     | 179,3     |
| 93                    | 122                   | 1                      | 0,6                     | 101,8                   | 63                           | 39,5                           | 13 000                                     | 20 000  | 256   | 997    | 2 159  | 736   | 2 927  | 6 484  | 181,3  | 295,9     | 398       |
| 93                    | 122                   | 1                      | 0,6                     | 101,8                   | 63                           | 40                             | 13 000                                     | 19 000  | 291   | 874    | 1 747  | 853   | 2 645  | 5 457  | 118,6  | 180,9     | 241,3     |
| 93                    | 122                   | 1                      | 0,6                     | 101,8                   | 63                           | 38                             | 16 000                                     | 24 000  | 200   | 601    | 1 201  | 581   | 1 784  | 3 656  | 116,8  | 175,4     | 230,5     |
| 93                    | 122                   | 1                      | 0,6                     | 103,9                   | 30,5                         | 22,7                           | 15 000                                     | 22 000  | 107   | 322    | 643    | 320   | 1 006  | 2 093  | 60,3   | 94,4      | 128,8     |
| 93                    | 122                   | 1                      | 0,6                     | 103,9                   | 29                           | 21,4                           | 13 000                                     | 20 000  | 173   | 518    | 1 035  | 497   | 1 520  | 3 099  | 150,8  | 224,3     | 292,1     |
| 93                    | 122                   | 1                      | 0,6                     | 103,9                   | 29                           | 20,5                           | 17 000                                     | 26 000  | 120   | 359    | 718    | 343   | 1 042  | 2 115  | 150,1  | 221,3     | 285,5     |
| 93                    | 122                   | 1                      | 0,6                     | 103,9                   | 44,5                         | 20,5                           | 19 000                                     | 30 000  | 120   | 359    | 718    | 343   | 1 042  | 2 115  | 150,1  | 221,3     | 285,5     |
| 98                    | 138                   | 2                      | 2                       | 112,3                   | 97                           | 59                             | 9 000                                      | 15 000  | 568   | 1 786  | 3 544  | 1 759   | 5 983  | 12 688 | 99,1   | 167,1     | 237,5     |
| 98                    | 138                   | 2                      | 2                       | 112,3                   | 93                           | 57                             | 8 000                                      | 13 000  | 864   | 2 869  | 5 921  | 2 520   | 8 657  | 18 466 | 233,1  | 368,5     | 497,4     |
| 98                    | 138                   | 2                      | 2                       | 112,3                   | 97                           | 57                             | 11 000                                     | 18 000  | 306   | 1 012  | 2 071  | 915   | 3 205  | 6 915  | 86,2   | 141,9     | 198       |
| 98                    | 138                   | 2                      | 2                       | 112,3                   | 93                           | 54                             | 10 000                                     | 17 000  | 438   | 1 572  | 3 325  | 1 262   | 4 626  | 10 015 | 206,4  | 328       | 420,1     |

# Spindle bearings

With large or small balls  
 Steel or ceramic balls  
 Steel or Cronidur rings  
 Open or sealed  
 Design DLR



**Dimension table** (continued) · Dimensions in mm

| Designation <sup>1)</sup> |                         |                         | Mass<br>m<br>≈ kg | Dimensions |     |    |     |                |                |                |                | Contact angle<br>α<br>° |
|---------------------------|-------------------------|-------------------------|-------------------|------------|-----|----|-----|----------------|----------------|----------------|----------------|-------------------------|
| Series 719 <sup>4)</sup>  | Series 70 <sup>4)</sup> | Series 72 <sup>4)</sup> |                   | d          | D   | B  | r   | r <sub>1</sub> | B <sub>N</sub> | S <sub>N</sub> | S <sub>B</sub> |                         |
| <b>B71918-C-T-P4S</b>     | –                       | –                       | 0,559             | <b>90</b>  | 125 | 18 | 1,1 | 1,1            | –              | –              | –              | 15                      |
| <b>B71918-E-T-P4S</b>     | –                       | –                       | 0,557             | <b>90</b>  | 125 | 18 | 1,1 | 1,1            | –              | –              | –              | 25                      |
| <b>HCB71918-C-T-P4S</b>   | –                       | –                       | 0,464             | <b>90</b>  | 125 | 18 | 1,1 | 1,1            | 4              | 10,4           | 2,2            | 15                      |
| <b>HCB71918-E-T-P4S</b>   | –                       | –                       | 0,462             | <b>90</b>  | 125 | 18 | 1,1 | 1,1            | 4              | 10,4           | 2,2            | 25                      |
| <b>RS71918-D-T-P4S</b>    | –                       | –                       | 0,55              | <b>90</b>  | 125 | 18 | 1,1 | 1,1            | –              | –              | –              | 20                      |
| <b>HCRS71918-D-T-P4S</b>  | –                       | –                       | 0,47              | <b>90</b>  | 125 | 18 | 1,1 | 1,1            | 4              | 10,4           | 2,2            | 20                      |
| <b>HS71918-C-T-P4S</b>    | –                       | –                       | 0,58              | <b>90</b>  | 125 | 18 | 1,1 | –              | –              | –              | –              | 15                      |
| <b>HS71918-E-T-P4S</b>    | –                       | –                       | 0,579             | <b>90</b>  | 125 | 18 | 1,1 | –              | –              | –              | –              | 25                      |
| <b>HC71918-E-T-P4S</b>    | –                       | –                       | 0,629             | <b>90</b>  | 125 | 18 | 1,1 | –              | 4              | 10,4           | 2,2            | 25                      |
| <b>XC71918-E-T-P4S</b>    | –                       | –                       | 0,629             | <b>90</b>  | 125 | 18 | 1,1 | –              | 4              | 10,4           | 2,2            | 25                      |
| –                         | <b>B7018-C-T-P4S</b>    | –                       | 1,13              | <b>90</b>  | 140 | 24 | 1,5 | 1,5            | –              | –              | –              | 15                      |
| –                         | <b>B7018-E-T-P4S</b>    | –                       | 1,12              | <b>90</b>  | 140 | 24 | 1,5 | 1,5            | –              | –              | –              | 25                      |
| –                         | <b>HCB7018-C-T-P4S</b>  | –                       | 0,956             | <b>90</b>  | 140 | 24 | 1,5 | 1,5            | 5,5            | 14,5           | 2,2            | 15                      |
| –                         | <b>HCB7018-E-T-P4S</b>  | –                       | 0,952             | <b>90</b>  | 140 | 24 | 1,5 | 1,5            | 5,5            | 14,5           | 2,2            | 25                      |
| –                         | <b>RS7018-D-T-P4S</b>   | –                       | 1,14              | <b>90</b>  | 140 | 24 | 1,5 | 1,5            | –              | –              | –              | 20                      |
| –                         | <b>HCRS7018-D-T-P4S</b> | –                       | 1,14              | <b>90</b>  | 140 | 24 | 1,5 | 1,5            | 5,5            | 14,5           | 2,2            | 20                      |
| –                         | <b>HS7018-C-T-P4S</b>   | –                       | 1,27              | <b>90</b>  | 140 | 24 | 1,5 | –              | –              | –              | –              | 15                      |
| –                         | <b>HS7018-E-T-P4S</b>   | –                       | 1,27              | <b>90</b>  | 140 | 24 | 1,5 | –              | –              | –              | –              | 25                      |
| –                         | <b>HC7018-E-T-P4S</b>   | –                       | 1,31              | <b>90</b>  | 140 | 24 | 1,5 | –              | 5,5            | 14,5           | 2,2            | 25                      |
| –                         | <b>XC7018-E-T-P4S</b>   | –                       | 1,31              | <b>90</b>  | 140 | 24 | 1,5 | –              | 5,5            | 14,5           | 2,2            | 25                      |
| –                         | –                       | <b>B7218-C-T-P4S</b>    | 2,2               | <b>90</b>  | 160 | 30 | 2   | 2              | –              | –              | –              | 15                      |
| –                         | –                       | <b>B7218-E-T-P4S</b>    | 2,19              | <b>90</b>  | 160 | 30 | 2   | 2              | –              | –              | –              | 25                      |
| –                         | –                       | <b>HCB7218-C-T-P4S</b>  | 1,8               | <b>90</b>  | 160 | 30 | 2   | 2              | –              | –              | –              | 15                      |
| –                         | –                       | <b>HCB7218-E-T-P4S</b>  | 1,79              | <b>90</b>  | 160 | 30 | 2   | 2              | –              | –              | –              | 25                      |

<sup>1)</sup> Explanation of short designations, see page 130.

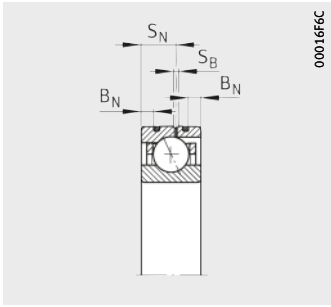
<sup>2)</sup> The limiting speeds in the dimension tables are based on elastically preloaded single bearings.

<sup>3)</sup> Explanation, see page 62.

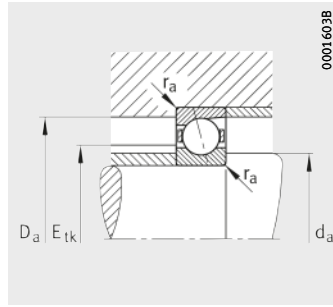
<sup>4)</sup> The bearings are also available with gap seals (type HSS, HCS, XCS or suffix 2RSD).  
 Ordering examples: B7018-C-2RSD-T-P4S-UL and HSS7018-E-T-P4S-UL.

<sup>5)</sup> Minimal quantity oil lubrication.

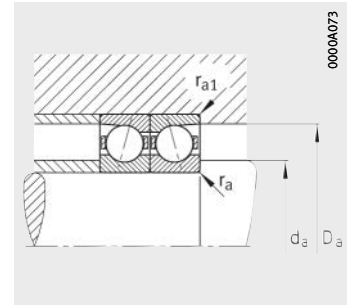
<sup>6)</sup> Ordering examples for Direct Lube design: HCB7018-EDLR-T-P4S-UL and HC7018-EDLR-T-P4S-UL.  
 DLR only up to bore code 22.



Design DLR<sup>6)</sup>



Mounting dimensions



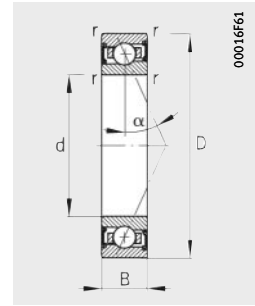
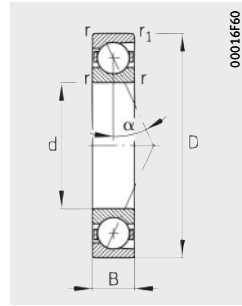
Mounting dimensions



| Mounting dimensions   |                       |                        |                         |                         | Basic load ratings           |                                | Limiting speeds <sup>2)</sup>              |   | Preload force <sup>3)</sup><br>F <sub>v</sub> |        |        | Lift-off force <sup>3)</sup><br>K <sub>aE</sub> |        |        | Axial rigidity <sup>3)</sup><br>c <sub>a</sub> |           |           |
|-----------------------|-----------------------|------------------------|-------------------------|-------------------------|------------------------------|--------------------------------|--|---|---|--------|--------|---|--------|--------|--|-----------|-----------|
| d <sub>a</sub><br>h12 | D <sub>a</sub><br>H12 | r <sub>a</sub><br>max. | r <sub>a1</sub><br>max. | E <sub>tk</sub><br>nom. | dyn.<br>C <sub>r</sub><br>kN | stat.<br>C <sub>0r</sub><br>kN | n <sub>G</sub> grease<br>min <sup>-1</sup> | n <sub>G</sub> oil <sup>5)</sup><br>min <sup>-1</sup> | L<br>N  | M<br>N | H<br>N | L<br>N  | M<br>N | H<br>N | L<br>N/μm                                      | M<br>N/μm | H<br>N/μm |
| 97                    | 119                   | 0,6                    | 0,6                     | 104,2                   | 48                           | 35                             | 11 000                                     | 16 000  | 238   | 796    | 1 615  | 729   | 2 628  | 5 691  | 81,8   | 139,8     | 199,5     |
| 97                    | 119                   | 0,6                    | 0,6                     | 104,2                   | 45                           | 33                             | 9 500                                      | 15 000  | 334   | 1 236  | 2 634  | 970   | 3 701  | 8 140  | 189,4  | 309       | 420,3     |
| 97                    | 119                   | 0,6                    | 0,6                     | 104,2                   | 48                           | 33,5                           | 15 000                                     | 22 000  | 118   | 434    | 919    | 349   | 1 357  | 3 023  | 69,4   | 117,7     | 165,4     |
| 97                    | 119                   | 0,6                    | 0,6                     | 104,2                   | 45                           | 31,5                           | 13 000                                     | 20 000  | 147   | 648    | 1 450  | 421   | 1 897  | 4 337  | 160,1  | 272       | 369,3     |
| 97                    | 119                   | 0,6                    | 0,6                     | 104,2                   | 44                           | 31                             | 13 000                                     | 19 000  | 216   | 647    | 1 293  | 629   | 1 942  | 3 994  | 122,8  | 186       | 246,5     |
| 97                    | 119                   | 0,6                    | 0,6                     | 104,2                   | 44                           | 29,5                           | 16 000                                     | 24 000  | 146   | 438    | 877    | 422   | 1 293  | 2 643  | 120,6  | 180,1     | 215,5     |
| 97                    | 119                   | 0,6                    | 0,6                     | 104,5                   | 23,2                         | 18,7                           | 15 000                                     | 22 000  | 79  | 237    | 474    | 235   | 739    | 1 536  | 57,2   | 89,4      | 121,6     |
| 97                    | 119                   | 0,6                    | 0,6                     | 104,5                   | 21,9                         | 17,7                           | 13 000                                     | 20 000  | 129   | 386    | 773    | 371   | 1 133  | 2 309  | 144,3  | 214,4     | 278,7     |
| 97                    | 119                   | 0,6                    | 0,6                     | 104,5                   | 21,9                         | 16,9                           | 17 000                                     | 26 000  | 90  | 269    | 538    | 257   | 781    | 1 584  | 143,9  | 212       | 273,2     |
| 97                    | 119                   | 0,6                    | 0,6                     | 104,5                   | 33,5                         | 16,9                           | 19 000                                     | 30 000  | 90  | 269    | 538    | 257   | 781    | 1 584  | 143,9  | 212       | 273,2     |
| 100                   | 131                   | 1,5                    | 0,6                     | 108,6                   | 78                           | 51                             | 10 000                                     | 15 000  | 437   | 1 395  | 2 785  | 1 347   | 4 651  | 9 920  | 95,2   | 161       | 229,09    |
| 100                   | 131                   | 1,5                    | 0,6                     | 108,6                   | 74                           | 48,5                           | 9 000                                      | 14 000  | 646   | 2 205  | 4 590  | 1 880   | 6 636  | 14 269 | 222,6  | 354,6     | 479,4     |
| 100                   | 131                   | 1,5                    | 0,6                     | 108,6                   | 78                           | 49                             | 14 000                                     | 22 000  | 230   | 781    | 1 613  | 685   | 2 464  | 5 361  | 82,3   | 136,3     | 190,6     |
| 100                   | 131                   | 1,5                    | 0,6                     | 108,6                   | 74                           | 46,5                           | 12 000                                     | 19 000  | 319   | 1 201  | 2 577  | 916   | 3 528  | 7 745  | 195,4  | 315,5     | 423,1     |
| 100                   | 131                   | 1,5                    | 0,6                     | 108,6                   | 73                           | 45,5                           | 12 000                                     | 18 000  | 341   | 1 024  | 2 048  | 1 000   | 3 100  | 6 395  | 125,2  | 190,9     | 254,6     |
| 100                   | 131                   | 1,5                    | 0,6                     | 108,6                   | 73                           | 44                             | 15 000                                     | 24 000  | 237   | 710    | 1 420  | 686   | 2 109  | 4 322  | 123,6  | 185,6     | 244       |
| 100                   | 131                   | 1,5                    | 0,6                     | 111                     | 36                           | 26,5                           | 14 000                                     | 22 000  | 126   | 377    | 754    | 375   | 1 178  | 2 451  | 65,4   | 102,3     | 139,5     |
| 100                   | 131                   | 1,5                    | 0,6                     | 111                     | 34                           | 25                             | 12 000                                     | 19 000  | 204   | 612    | 1 225  | 588   | 1 799  | 3 667  | 164,2  | 244,2     | 317,9     |
| 100                   | 131                   | 1,5                    | 0,6                     | 111                     | 34                           | 24                             | 16 000                                     | 24 000  | 141   | 423    | 845    | 404   | 1 228  | 2 490  | 163,2  | 240,5     | 310,3     |
| 100                   | 131                   | 1,5                    | 0,6                     | 111                     | 52                           | 24                             | 18 000                                     | 28 000  | 141   | 423    | 845    | 404   | 1 228  | 2 490  | 163,2  | 240,5     | 310,3     |
| 104                   | 147                   | 2                      | 2                       | 118,8                   | 125                          | 75                             | 8 500                                      | 14 000  | 732   | 2 280  | 4 513  | 2 267   | 7 640  | 16 156 | 108,9  | 182,8     | 259,5     |
| 104                   | 147                   | 2                      | 2                       | 118,8                   | 119                          | 72                             | 7 500                                      | 12 000  | 1 127   | 3 689  | 7 575  | 3 291   | 11 132 | 23 627 | 257,1  | 404,3     | 544,6     |
| 104                   | 147                   | 2                      | 2                       | 118,8                   | 125                          | 72                             | 11 000                                     | 18 000  | 400   | 1 303  | 2 655  | 1 197   | 4 129  | 8 866  | 95,2   | 155,8     | 217       |
| 104                   | 147                   | 2                      | 2                       | 118,8                   | 119                          | 69                             | 9 000                                      | 15 000  | 586   | 2 042  | 4 283  | 1 688   | 6 013  | 12 905 | 229,5  | 361,2     | 464,2     |

# Spindle bearings

- With large or small balls
- Steel or ceramic balls
- Steel rings
- Open or sealed
- Design DLR



**Dimension table** (continued) · Dimensions in mm

| Designation <sup>1)</sup> |                         |                        | Mass<br>m<br>≈ kg | Dimensions |     |    |     |                |                |                |                | Contact angle<br>α<br>° |
|---------------------------|-------------------------|------------------------|-------------------|------------|-----|----|-----|----------------|----------------|----------------|----------------|-------------------------|
| Series 719 <sup>4)</sup>  | Series 70 <sup>4)</sup> | Series 72              |                   | d          | D   | B  | r   | r <sub>1</sub> | B <sub>N</sub> | S <sub>N</sub> | S <sub>B</sub> |                         |
| <b>B71919-C-T-P4S</b>     | –                       | –                      | 0,583             | <b>95</b>  | 130 | 18 | 1,1 | 1,1            | –              | –              | –              | 15                      |
| <b>B71919-E-T-P4S</b>     | –                       | –                      | 0,581             | <b>95</b>  | 130 | 18 | 1,1 | 1,1            | –              | –              | –              | 25                      |
| <b>HCB71919-C-T-P4S</b>   | –                       | –                      | 0,484             | <b>95</b>  | 130 | 18 | 1,1 | 1,1            | 4              | 10,4           | 2,2            | 15                      |
| <b>HCB71919-E-T-P4S</b>   | –                       | –                      | 0,482             | <b>95</b>  | 130 | 18 | 1,1 | 1,1            | 4              | 10,4           | 2,2            | 25                      |
| <b>RS71919-D-T-P4S</b>    | –                       | –                      | 0,58              | <b>95</b>  | 130 | 18 | 1,1 | 1,1            | –              | –              | –              | 20                      |
| <b>HCRS71919-D-T-P4S</b>  | –                       | –                      | 0,48              | <b>95</b>  | 130 | 18 | 1,1 | 1,1            | 4              | 10,4           | 2,2            | 20                      |
| <b>HS71919-C-T-P4S</b>    | –                       | –                      | 0,606             | <b>95</b>  | 130 | 18 | 1,1 | –              | –              | –              | –              | 15                      |
| <b>HS71919-E-T-P4S</b>    | –                       | –                      | 0,605             | <b>95</b>  | 130 | 18 | 1,1 | –              | –              | –              | –              | 25                      |
| <b>HC71919-E-T-P4S</b>    | –                       | –                      | 0,658             | <b>95</b>  | 130 | 18 | 1,1 | –              | 4              | 10,4           | 2,2            | 25                      |
| <b>XC71919-E-T-P4S</b>    | –                       | –                      | 0,658             | <b>95</b>  | 130 | 18 | 1,1 | –              | 4              | 10,4           | 2,2            | 25                      |
| –                         | <b>B7019-C-T-P4S</b>    | –                      | 1,19              | <b>95</b>  | 145 | 24 | 1,5 | 1,5            | –              | –              | –              | 15                      |
| –                         | <b>B7019-E-T-P4S</b>    | –                      | 1,18              | <b>95</b>  | 145 | 24 | 1,5 | 1,5            | –              | –              | –              | 25                      |
| –                         | <b>HCB7019-C-T-P4S</b>  | –                      | 0,999             | <b>95</b>  | 145 | 24 | 1,5 | 1,5            | 5,5            | 14,5           | 2,2            | 15                      |
| –                         | <b>HCB7019-E-T-P4S</b>  | –                      | 0,995             | <b>95</b>  | 145 | 24 | 1,5 | 1,5            | 5,5            | 14,5           | 2,2            | 25                      |
| –                         | <b>RS7019-D-T-P4S</b>   | –                      | 1,19              | <b>95</b>  | 145 | 24 | 1,5 | 1,5            | –              | –              | –              | 20                      |
| –                         | <b>HCRS7019-D-T-P4S</b> | –                      | 1,19              | <b>95</b>  | 145 | 24 | 1,5 | 1,5            | 5,5            | 14,5           | 2,2            | 20                      |
| –                         | <b>HS7019-C-T-P4S</b>   | –                      | 1,32              | <b>95</b>  | 145 | 24 | 1,5 | –              | –              | –              | –              | 15                      |
| –                         | <b>HS7019-E-T-P4S</b>   | –                      | 1,32              | <b>95</b>  | 145 | 24 | 1,5 | –              | –              | –              | –              | 25                      |
| –                         | <b>HC7019-E-T-P4S</b>   | –                      | 1,36              | <b>95</b>  | 145 | 24 | 1,5 | –              | 5,5            | 14,5           | 2,2            | 25                      |
| –                         | <b>XC7019-E-T-P4S</b>   | –                      | 1,36              | <b>95</b>  | 145 | 24 | 1,5 | –              | 5,5            | 14,5           | 2,2            | 25                      |
| –                         | –                       | <b>B7219-C-T-P4S</b>   | 2,73              | <b>95</b>  | 170 | 32 | 2,1 | 2,1            | –              | –              | –              | 15                      |
| –                         | –                       | <b>B7219-E-T-P4S</b>   | 2,72              | <b>95</b>  | 170 | 32 | 2,1 | 2,1            | –              | –              | –              | 25                      |
| –                         | –                       | <b>HCB7219-C-T-P4S</b> | 2,3               | <b>95</b>  | 170 | 32 | 2,1 | 2,1            | –              | –              | –              | 15                      |
| –                         | –                       | <b>HCB7219-E-T-P4S</b> | 2,29              | <b>95</b>  | 170 | 32 | 2,1 | 2,1            | –              | –              | –              | 25                      |

<sup>1)</sup> Explanation of short designations, see page 130.

<sup>2)</sup> The limiting speeds in the dimension tables are based on elastically preloaded single bearings.

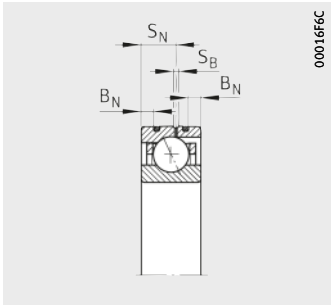
<sup>3)</sup> Explanation, see page 62.

<sup>4)</sup> The bearings are also available with gap seals (type HSS, HCS, XCS or suffix 2RSD).  
Ordering examples: B7019-C-2RSD-T-P4S-UL and HSS7019-E-T-P4S-UL.

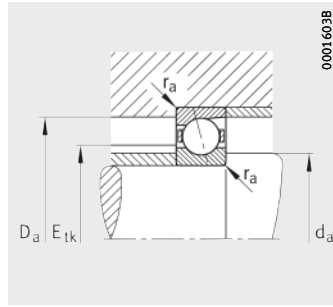
<sup>5)</sup> Minimal quantity oil lubrication.

<sup>6)</sup> Ordering examples for Direct Lube design: HCB7019-EDLR-T-P4S-UL and HC7019-EDLR-T-P4S-UL.  
DLR only up to bore code 22.

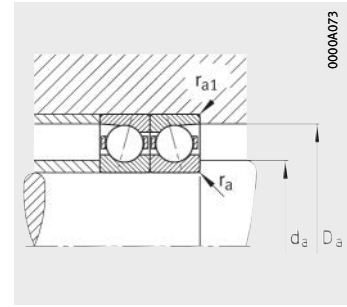




Design DLR<sup>6)</sup>



Mounting dimensions



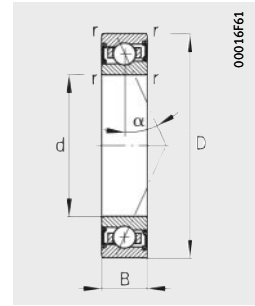
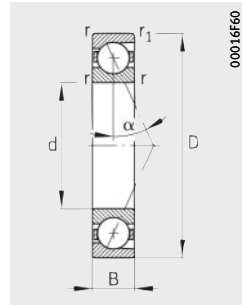
Mounting dimensions



| Mounting dimensions   |                       |                        |                         |                         | Basic load ratings           |                                | Limiting speeds <sup>2)</sup>              |   | Preload force <sup>3)</sup> |       |       | Lift-off force <sup>3)</sup> |        |        | Axial rigidity <sup>3)</sup> |       |       |
|-----------------------|-----------------------|------------------------|-------------------------|-------------------------|------------------------------|--------------------------------|--|---|-----------------------------|-------|-------|------------------------------|--------|--------|------------------------------|-------|-------|
| d <sub>a</sub><br>h12 | D <sub>a</sub><br>H12 | r <sub>a</sub><br>max. | r <sub>a1</sub><br>max. | E <sub>tk</sub><br>nom. | dyn.<br>C <sub>r</sub><br>kN | stat.<br>C <sub>0r</sub><br>kN | n <sub>G</sub> grease<br>min <sup>-1</sup> | n <sub>G</sub> oil <sup>5)</sup><br>min <sup>-1</sup> | F <sub>v</sub>              |       |       | K <sub>aE</sub>              |        |        | c <sub>a</sub>               |       |       |
|                       |                       |                        |                         |                         |                              |                                |  |   | L                           | M     | H     | L                            | M      | H      | L                            | M     | H     |
|                       |                       |                        |                         |                         |                              |                                |  |   | N                           | N     | N     | N                            | N      | N      | N/μm                         | N/μm  | N/μm  |
| 102                   | 124                   | 0,6                    | 0,6                     | 109,2                   | 48,5                         | 36,5                           | 10 000                                     | 16 000  | 243                         | 813   | 1 651 | 743                          | 2 679  | 5 806  | 84,4                         | 144,1 | 205,6 |
| 102                   | 124                   | 0,6                    | 0,6                     | 109,2                   | 46                           | 34,5                           | 9 000                                      | 14 000  | 341                         | 1 262 | 2 693 | 988                          | 3 777  | 8 313  | 195,5                        | 319,1 | 433,9 |
| 102                   | 124                   | 0,6                    | 0,6                     | 109,2                   | 48,5                         | 35                             | 14 000                                     | 22 000  | 119                         | 440   | 932   | 352                          | 1 373  | 3 061  | 71,3                         | 121   | 170   |
| 102                   | 124                   | 0,6                    | 0,6                     | 109,2                   | 46                           | 33                             | 13 000                                     | 19 000  | 148                         | 656   | 1 470 | 423                          | 1 918  | 4 393  | 164,4                        | 280   | 380,3 |
| 102                   | 124                   | 0,6                    | 0,6                     | 109,2                   | 45                           | 32,5                           | 12 000                                     | 18 000  | 218                         | 654   | 1 308 | 635                          | 1 961  | 4 033  | 126,4                        | 191,3 | 253,3 |
| 102                   | 124                   | 0,6                    | 0,6                     | 109,2                   | 45                           | 31                             | 15 000                                     | 24 000  | 148                         | 445   | 891   | 429                          | 1 314  | 2 684  | 124,4                        | 185,7 | 221,9 |
| 102                   | 124                   | 0,6                    | 0,6                     | 109,5                   | 23,9                         | 19,9                           | 14 000                                     | 22 000  | 82                          | 246   | 492   | 244                          | 766    | 1 593  | 60                           | 93,7  | 127,4 |
| 102                   | 124                   | 0,6                    | 0,6                     | 109,5                   | 22,5                         | 18,7                           | 13 000                                     | 19 000  | 131                         | 393   | 787   | 377                          | 1 153  | 2 347  | 150,4                        | 223,3 | 290,1 |
| 102                   | 124                   | 0,6                    | 0,6                     | 109,5                   | 22,5                         | 17,9                           | 16 000                                     | 24 000  | 92                          | 276   | 552   | 263                          | 801    | 1 623  | 150,4                        | 221,4 | 285,3 |
| 102                   | 124                   | 0,6                    | 0,6                     | 109,5                   | 34,5                         | 17,9                           | 18 000                                     | 28 000  | 92                          | 276   | 552   | 263                          | 801    | 1 623  | 150,4                        | 221,4 | 285,3 |
| 105                   | 136                   | 1,5                    | 0,6                     | 113,6                   | 81                           | 54                             | 9 500                                      | 15 000  | 444                         | 1 421 | 2 842 | 1 367                        | 4 726  | 10 091 | 98,8                         | 166,8 | 237,2 |
| 105                   | 136                   | 1,5                    | 0,6                     | 113,6                   | 77                           | 52                             | 8 500                                      | 13 000  | 671                         | 2 295 | 4 780 | 1 955                        | 6 904  | 14 849 | 233,2                        | 371,6 | 502,3 |
| 105                   | 136                   | 1,5                    | 0,6                     | 113,6                   | 81                           | 52                             | 13 000                                     | 20 000  | 233                         | 794   | 1 643 | 693                          | 2 499  | 5 442  | 85,3                         | 141,3 | 197,4 |
| 105                   | 136                   | 1,5                    | 0,6                     | 113,6                   | 77                           | 49,5                           | 12 000                                     | 18 000  | 322                         | 1 220 | 2 622 | 924                          | 3 581  | 7 871  | 202,7                        | 327,7 | 439,4 |
| 105                   | 136                   | 1,5                    | 0,6                     | 113,6                   | 75                           | 48,5                           | 11 000                                     | 17 000  | 348                         | 1 044 | 2 088 | 1 019                        | 3 158  | 6 512  | 130,2                        | 198,5 | 264,4 |
| 105                   | 136                   | 1,5                    | 0,6                     | 113,6                   | 75                           | 46,5                           | 14 000                                     | 22 000  | 241                         | 723   | 1 447 | 699                          | 2 148  | 4 400  | 128,6                        | 193   | 253,5 |
| 105                   | 136                   | 1,5                    | 0,6                     | 116                     | 36,5                         | 27,5                           | 13 000                                     | 20 000  | 127                         | 382   | 764   | 380                          | 1 192  | 2 480  | 67                           | 104,8 | 142,9 |
| 105                   | 136                   | 1,5                    | 0,6                     | 116                     | 34                           | 26                             | 12 000                                     | 18 000  | 204                         | 612   | 1 225 | 588                          | 1 797  | 3 663  | 167,7                        | 249,3 | 324,4 |
| 105                   | 136                   | 1,5                    | 0,6                     | 116                     | 34                           | 25                             | 15 000                                     | 24 000  | 141                         | 423   | 845   | 404                          | 1 227  | 2 488  | 166,7                        | 245,6 | 316,7 |
| 105                   | 136                   | 1,5                    | 0,6                     | 116                     | 52                           | 25                             | 17 000                                     | 26 000  | 141                         | 423   | 845   | 404                          | 1 227  | 2 488  | 166,7                        | 245,6 | 316,7 |
| 110,5                 | 154                   | 2                      | 2                       | 125,8                   | 130                          | 81                             | 8 000                                      | 13 000  | 760                         | 2 373 | 4 703 | 2 353                        | 7 935  | 16 792 | 114,9                        | 192,7 | 273,4 |
| 110,5                 | 154                   | 2                      | 2                       | 125,8                   | 124                          | 78                             | 7 000                                      | 11 000  | 1 184                       | 3 876 | 7 964 | 3 454                        | 11 693 | 24 820 | 272,7                        | 428,7 | 577,3 |
| 110,5                 | 154                   | 2                      | 2                       | 125,8                   | 130                          | 78                             | 10 000                                     | 17 000  | 413                         | 1 348 | 2 748 | 1 234                        | 4 261  | 9 153  | 100,3                        | 163,9 | 228,1 |
| 110,5                 | 154                   | 2                      | 2                       | 125,8                   | 124                          | 74                             | 8 500                                      | 14 000  | 605                         | 2 113 | 4 437 | 1 741                        | 6 219  | 13 355 | 241,9                        | 381   | 489,1 |

# Spindle bearings

With large or small balls  
 Steel or ceramic balls  
 Steel or Cronidur rings  
 Open or sealed  
 Design DLR



**Dimension table** (continued) · Dimensions in mm

| Designation <sup>1)</sup> |                         |                        | Mass<br>m<br>≈ kg | Dimensions |     |    |     |                |                |                |                | Contact angle<br>α<br>° |  |
|---------------------------|-------------------------|------------------------|-------------------|------------|-----|----|-----|----------------|----------------|----------------|----------------|-------------------------|--|
| Series 719 <sup>4)</sup>  | Series 70 <sup>4)</sup> | Series 72              |                   | d          | D   | B  | r   | r <sub>1</sub> | B <sub>N</sub> | S <sub>N</sub> | S <sub>B</sub> |                         |  |
|                           |                         |                        |                   |            |     |    |     |                |                |                |                |                         |  |
|                           |                         |                        |                   |            |     |    |     | min.           |                |                |                |                         |  |
| <b>B71920-C-T-P4S</b>     | –                       | –                      | 0,772             | <b>100</b> | 140 | 20 | 1,1 | 1,1            | –              | –              | –              | 15                      |  |
| <b>B71920-E-T-P4S</b>     | –                       | –                      | 0,769             | <b>100</b> | 140 | 20 | 1,1 | 1,1            | –              | –              | –              | 25                      |  |
| <b>HCB71920-C-T-P4S</b>   | –                       | –                      | 0,658             | <b>100</b> | 140 | 20 | 1,1 | 1,1            | 4              | 12             | 2,2            | 15                      |  |
| <b>HCB71920-E-T-P4S</b>   | –                       | –                      | 0,655             | <b>100</b> | 140 | 20 | 1,1 | 1,1            | 4              | 12             | 2,2            | 25                      |  |
| <b>RS71920-D-T-P4S</b>    | –                       | –                      | 0,79              | <b>100</b> | 140 | 20 | 1,1 | 1,1            | –              | –              | –              | 20                      |  |
| <b>HCRS71920-D-T-P4S</b>  | –                       | –                      | 0,66              | <b>100</b> | 140 | 20 | 1,1 | 1,1            | 4              | 12             | 2,2            | 20                      |  |
| <b>HS71920-C-T-P4S</b>    | –                       | –                      | 0,858             | <b>100</b> | 140 | 20 | 1,1 | –              | –              | –              | –              | 15                      |  |
| <b>HS71920-E-T-P4S</b>    | –                       | –                      | 0,856             | <b>100</b> | 140 | 20 | 1,1 | –              | –              | –              | –              | 25                      |  |
| <b>HC71920-E-T-P4S</b>    | –                       | –                      | 0,892             | <b>100</b> | 140 | 20 | 1,1 | –              | 4              | 12             | 2,2            | 25                      |  |
| <b>XC71920-E-T-P4S</b>    | –                       | –                      | 0,892             | <b>100</b> | 140 | 20 | 1,1 | –              | 4              | 12             | 2,2            | 25                      |  |
| –                         | <b>B7020-C-T-P4S</b>    | –                      | 1,24              | <b>100</b> | 150 | 24 | 1,5 | 1,5            | –              | –              | –              | 15                      |  |
| –                         | <b>B7020-E-T-P4S</b>    | –                      | 1,23              | <b>100</b> | 150 | 24 | 1,5 | 1,5            | –              | –              | –              | 25                      |  |
| –                         | <b>HCB7020-C-T-P4S</b>  | –                      | 1,04              | <b>100</b> | 150 | 24 | 1,5 | 1,5            | 5,5            | 14,5           | 2,2            | 15                      |  |
| –                         | <b>HCB7020-E-T-P4S</b>  | –                      | 1,04              | <b>100</b> | 150 | 24 | 1,5 | 1,5            | 5,5            | 14,5           | 2,2            | 25                      |  |
| –                         | <b>RS7020-D-T-P4S</b>   | –                      | 1,26              | <b>100</b> | 150 | 24 | 1,5 | 1,5            | –              | –              | –              | 20                      |  |
| –                         | <b>HCRS7020-D-T-P4S</b> | –                      | 1,26              | <b>100</b> | 150 | 24 | 1,5 | 1,5            | 5,5            | 14,5           | 2,2            | 20                      |  |
| –                         | <b>HS7020-C-T-P4S</b>   | –                      | 1,38              | <b>100</b> | 150 | 24 | 1,5 | –              | –              | –              | –              | 15                      |  |
| –                         | <b>HS7020-E-T-P4S</b>   | –                      | 1,37              | <b>100</b> | 150 | 24 | 1,5 | –              | –              | –              | –              | 25                      |  |
| –                         | <b>HC7020-E-T-P4S</b>   | –                      | 1,42              | <b>100</b> | 150 | 24 | 1,5 | –              | 5,5            | 14,5           | 2,2            | 25                      |  |
| –                         | <b>XC7020-E-T-P4S</b>   | –                      | 1,42              | <b>100</b> | 150 | 24 | 1,5 | –              | 5,5            | 14,5           | 2,2            | 25                      |  |
| –                         | –                       | <b>B7220-C-T-P4S</b>   | 3,35              | <b>100</b> | 180 | 34 | 2,1 | 2,1            | –              | –              | –              | 15                      |  |
| –                         | –                       | <b>B7220-E-T-P4S</b>   | 3,34              | <b>100</b> | 180 | 34 | 2,1 | 2,1            | –              | –              | –              | 25                      |  |
| –                         | –                       | <b>HCB7220-C-T-P4S</b> | 2,89              | <b>100</b> | 180 | 34 | 2,1 | 2,1            | –              | –              | –              | 15                      |  |
| –                         | –                       | <b>HCB7220-E-T-P4S</b> | 2,88              | <b>100</b> | 180 | 34 | 2,1 | 2,1            | –              | –              | –              | 25                      |  |

<sup>1)</sup> Explanation of short designations, see page 130.

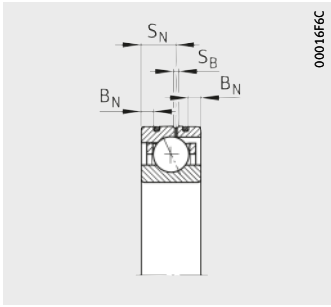
<sup>2)</sup> The limiting speeds in the dimension tables are based on elastically preloaded single bearings.

<sup>3)</sup> Explanation, see page 62.

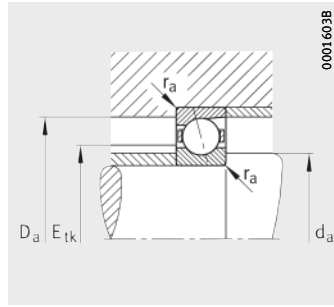
<sup>4)</sup> The bearings are also available with gap seals (type HSS, HCS, XCS or suffix 2RSD).  
 Ordering examples: B7020-C-2RSD-T-P4S-UL and HSS7020-E-T-P4S-UL.

<sup>5)</sup> Minimal quantity oil lubrication.

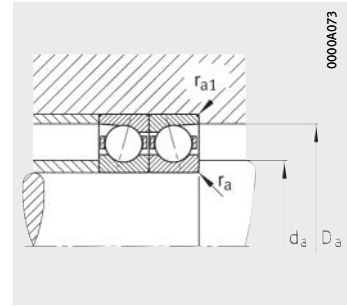
<sup>6)</sup> Ordering examples for Direct Lube design: HCB7020-EDLR-T-P4S-UL and HC7020-EDLR-T-P4S-UL.  
 DLR only up to bore code 22.



Design DLR<sup>6)</sup>



Mounting dimensions



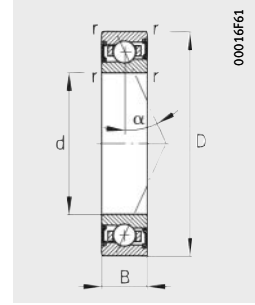
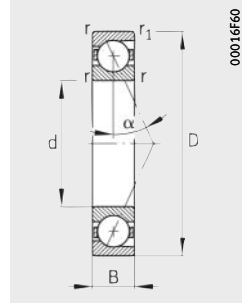
Mounting dimensions



| Mounting dimensions   |                       |                |                 |                 | Basic load ratings     |                          | Limiting speeds <sup>2)</sup> |                                  | Preload force <sup>3)</sup> |       |       | Lift-off force <sup>3)</sup> |        |        | Axial rigidity <sup>3)</sup> |       |        |
|-----------------------|-----------------------|----------------|-----------------|-----------------|------------------------|--------------------------|-------------------------------|----------------------------------|-----------------------------|-------|-------|------------------------------|--------|--------|------------------------------|-------|--------|
| d <sub>a</sub><br>h12 | D <sub>a</sub><br>H12 | r <sub>a</sub> | r <sub>a1</sub> | E <sub>tk</sub> | dyn.<br>C <sub>r</sub> | stat.<br>C <sub>0r</sub> | n <sub>G</sub> grease         | n <sub>G</sub> oil <sup>5)</sup> | F <sub>V</sub>              |       |       | K <sub>aE</sub>              |        |        | c <sub>a</sub>               |       |        |
|                       |                       | max.           |                 | nom.            | kN                     | kN                       | min <sup>-1</sup>             | min <sup>-1</sup>                | L                           | M     | H     | L                            | M      | H      | L                            | M     | H      |
|                       |                       |                |                 |                 |                        |                          |                               |                                  | N                           | N     | N     | N                            | N      | N      | N/μm                         | N/μm  | N/μm   |
| 107                   | 133                   | 0,6            | 0,6             | 117,2           | 60                     | 45                       | 9 500                         | 14 000                           | 316                         | 1 040 | 2 101 | 968                          | 3 432  | 7 399  | 94,1                         | 159,8 | 227,5  |
| 107                   | 133                   | 0,6            | 0,6             | 117,2           | 57                     | 42,5                     | 8 500                         | 13 000                           | 450                         | 1 616 | 3 417 | 1 305                        | 4 839  | 10 556 | 218,7                        | 353,4 | 478,9  |
| 107                   | 133                   | 0,6            | 0,6             | 117,2           | 60                     | 43                       | 13 000                        | 20 000                           | 160                         | 572   | 1 201 | 473                          | 1 789  | 3 950  | 80,4                         | 135   | 189,1  |
| 107                   | 133                   | 0,6            | 0,6             | 117,2           | 57                     | 40,5                     | 12 000                        | 18 000                           | 204                         | 850   | 1 876 | 584                          | 2 489  | 5 611  | 186,8                        | 311,4 | 420,5  |
| 107                   | 133                   | 0,6            | 0,6             | 117,2           | 56                     | 40,5                     | 11 000                        | 17 000                           | 273                         | 819   | 1 638 | 796                          | 2 457  | 5 052  | 138,8                        | 210,1 | 278,1  |
| 107                   | 133                   | 0,6            | 0,6             | 117,2           | 56                     | 38,5                     | 14 000                        | 22 000                           | 187                         | 560   | 1 121 | 540                          | 1 653  | 3 377  | 136,8                        | 204,2 | 246,9  |
| 107                   | 133                   | 0,6            | 0,6             | 116,7           | 28,5                   | 23,5                     | 13 000                        | 20 000                           | 97                          | 291   | 583   | 289                          | 906    | 1 883  | 64,6                         | 100,7 | 136,8  |
| 107                   | 133                   | 0,6            | 0,6             | 116,7           | 27                     | 22,1                     | 12 000                        | 18 000                           | 158                         | 474   | 949   | 455                          | 1 390  | 2 832  | 162,9                        | 241,8 | 314,3  |
| 107                   | 133                   | 0,6            | 0,6             | 116,7           | 27                     | 21,2                     | 15 000                        | 24 000                           | 109                         | 328   | 656   | 313                          | 951    | 1 927  | 162                          | 238,5 | 307,3  |
| 107                   | 133                   | 0,6            | 0,6             | 116,7           | 41                     | 21,2                     | 17 000                        | 26 000                           | 109                         | 328   | 656   | 313                          | 951    | 1 927  | 162                          | 238,5 | 307,3  |
| 110                   | 141                   | 1,5            | 0,6             | 118,6           | 83                     | 57                       | 9 000                         | 14 000                           | 464                         | 1 484 | 2 970 | 1 427                        | 4 935  | 10 539 | 103,5                        | 174,8 | 248,43 |
| 110                   | 141                   | 1,5            | 0,6             | 118,6           | 79                     | 55                       | 8 000                         | 13 000                           | 681                         | 2 336 | 4 869 | 1 982                        | 7 018  | 15 103 | 241,9                        | 385,4 | 520,6  |
| 110                   | 141                   | 1,5            | 0,6             | 118,6           | 83                     | 55                       | 13 000                        | 19 000                           | 241                         | 823   | 1 703 | 717                          | 2 587  | 5 636  | 89,1                         | 147,5 | 206    |
| 110                   | 141                   | 1,5            | 0,6             | 118,6           | 79                     | 52                       | 11 000                        | 17 000                           | 333                         | 1 266 | 2 723 | 957                          | 3 715  | 8 170  | 211,8                        | 342,6 | 459,3  |
| 110                   | 141                   | 1,5            | 0,6             | 118,6           | 77                     | 51,1                     | 11 000                        | 16 000                           | 355                         | 1 065 | 2 129 | 1 039                        | 3 217  | 6 630  | 135,3                        | 205,9 | 274,1  |
| 110                   | 141                   | 1,5            | 0,6             | 118,6           | 77                     | 49                       | 14 000                        | 22 000                           | 246                         | 737   | 1 474 | 712                          | 2 186  | 4 477  | 133,6                        | 200,4 | 263    |
| 110                   | 141                   | 1,5            | 0,6             | 121             | 36,5                   | 28,5                     | 13 000                        | 19 000                           | 127                         | 382   | 764   | 379                          | 1 190  | 2 476  | 68,3                         | 106,8 | 145,3  |
| 110                   | 141                   | 1,5            | 0,6             | 121             | 34,5                   | 27                       | 11 000                        | 17 000                           | 207                         | 621   | 1 242 | 596                          | 1 822  | 3 713  | 172                          | 255,7 | 332,5  |
| 110                   | 141                   | 1,5            | 0,6             | 121             | 34,5                   | 26                       | 15 000                        | 22 000                           | 144                         | 431   | 863   | 412                          | 1 252  | 2 539  | 171,4                        | 252,5 | 325,5  |
| 110                   | 141                   | 1,5            | 0,6             | 121             | 53                     | 26                       | 16 000                        | 24 000                           | 144                         | 431   | 863   | 412                          | 1 252  | 2 539  | 171,4                        | 252,5 | 325,5  |
| 114,5                 | 165,5                 | 2,1            | 2,1             | 132,4           | 135                    | 88                       | 7 500                         | 12 000                           | 789                         | 2 466 | 4 892 | 2 439                        | 8 230  | 17 428 | 120,8                        | 202,5 | 287,2  |
| 114,5                 | 165,5                 | 2,1            | 2,1             | 132,4           | 129                    | 84                       | 6 700                         | 10 000                           | 1 208                       | 3 964 | 8 152 | 3 521                        | 11 940 | 25 355 | 285,4                        | 448,6 | 603,7  |
| 114,5                 | 165,5                 | 2,1            | 2,1             | 132,4           | 135                    | 84                       | 9 500                         | 16 000                           | 428                         | 1 400 | 2 856 | 1 279                        | 4 420  | 9 498  | 105,5                        | 172,4 | 239,8  |
| 114,5                 | 165,5                 | 2,1            | 2,1             | 132,4           | 129                    | 80                       | 8 000                         | 13 000                           | 627                         | 2 198 | 4 619 | 1 806                        | 6 466  | 13 894 | 254,9                        | 401,6 | 515,3  |

# Spindle bearings

- With large or small balls
- Steel or ceramic balls
- Steel rings
- Open or sealed
- Design DLR



**Dimension table** (continued) · Dimensions in mm

| Designation <sup>1)</sup> |                         |                        | Mass<br>m<br>≈ kg | Dimensions |     |    |     |                |                |                |                | Contact angle<br>α<br>° |
|---------------------------|-------------------------|------------------------|-------------------|------------|-----|----|-----|----------------|----------------|----------------|----------------|-------------------------|
| Series 719 <sup>4)</sup>  | Series 70 <sup>4)</sup> | Series 72              |                   | d          | D   | B  | r   | r <sub>1</sub> | B <sub>N</sub> | S <sub>N</sub> | S <sub>B</sub> |                         |
|                           |                         |                        |                   |            |     |    |     |                |                |                |                |                         |
|                           |                         |                        |                   |            |     |    |     |                | min.           |                |                |                         |
| <b>B71921-C-T-P4S</b>     | –                       | –                      | 0,803             | <b>105</b> | 145 | 20 | 1,1 | 1,1            | –              | –              | –              | 15                      |
| <b>B71921-E-T-P4S</b>     | –                       | –                      | 0,8               | <b>105</b> | 145 | 20 | 1,1 | 1,1            | –              | –              | –              | 25                      |
| <b>HCB71921-C-T-P4S</b>   | –                       | –                      | 0,688             | <b>105</b> | 145 | 20 | 1,1 | 1,1            | 4              | 12             | 2,2            | 15                      |
| <b>HCB71921-E-T-P4S</b>   | –                       | –                      | 0,685             | <b>105</b> | 145 | 20 | 1,1 | 1,1            | 4              | 12             | 2,2            | 25                      |
| <b>RS71921-D-T-P4S</b>    | –                       | –                      | 0,8               | <b>105</b> | 145 | 20 | 1,1 | 1,1            | –              | –              | –              | 20                      |
| <b>HCRS71921-D-T-P4S</b>  | –                       | –                      | 0,7               | <b>105</b> | 145 | 20 | 1,1 | 1,1            | 4              | 12             | 2,2            | 20                      |
| <b>HS71921-C-T-P4S</b>    | –                       | –                      | 0,891             | <b>105</b> | 145 | 20 | 1,1 | –              | –              | –              | –              | 15                      |
| <b>HS71921-E-T-P4S</b>    | –                       | –                      | 0,87              | <b>105</b> | 145 | 20 | 1,1 | –              | –              | –              | –              | 25                      |
| <b>HC71921-E-T-P4S</b>    | –                       | –                      | 0,907             | <b>105</b> | 145 | 20 | 1,1 | –              | 4              | 12             | 2,2            | 25                      |
| <b>XC71921-E-T-P4S</b>    | –                       | –                      | 0,907             | <b>105</b> | 145 | 20 | 1,1 | –              | 4              | 12             | 2,2            | 25                      |
| –                         | <b>B7021-C-T-P4S</b>    | –                      | 1,61              | <b>105</b> | 160 | 26 | 2   | 2              | –              | –              | –              | 15                      |
| –                         | <b>B7021-E-T-P4S</b>    | –                      | 1,59              | <b>105</b> | 160 | 26 | 2   | 2              | –              | –              | –              | 25                      |
| –                         | <b>HCB7021-C-T-P4S</b>  | –                      | 1,4               | <b>105</b> | 160 | 26 | 2   | 2              | 5,5            | 15,5           | 2,2            | 15                      |
| –                         | <b>HCB7021-E-T-P4S</b>  | –                      | 1,39              | <b>105</b> | 160 | 26 | 2   | 2              | 5,5            | 15,5           | 2,2            | 25                      |
| –                         | <b>RS7021-D-T-P4S</b>   | –                      | 1,6               | <b>105</b> | 160 | 26 | 2   | 2              | –              | –              | –              | 20                      |
| –                         | <b>HCRS7021-D-T-P4S</b> | –                      | 1,6               | <b>105</b> | 160 | 26 | 2   | 2              | 5,5            | 15,5           | 2,2            | 20                      |
| –                         | <b>HS7021-C-T-P4S</b>   | –                      | 1,7               | <b>105</b> | 160 | 26 | 2   | –              | –              | –              | –              | 15                      |
| –                         | <b>HS7021-E-T-P4S</b>   | –                      | 1,7               | <b>105</b> | 160 | 26 | 2   | –              | –              | –              | –              | 25                      |
| –                         | <b>HC7021-E-T-P4S</b>   | –                      | 1,74              | <b>105</b> | 160 | 26 | 2   | –              | 5,5            | 15,5           | 2,2            | 25                      |
| –                         | <b>XC7021-E-T-P4S</b>   | –                      | 1,74              | <b>105</b> | 160 | 26 | 2   | –              | 5,5            | 15,5           | 2,2            | 25                      |
| –                         | –                       | <b>B7221-C-T-P4S</b>   | 3,89              | <b>105</b> | 190 | 36 | 2,1 | 2,1            | –              | –              | –              | 15                      |
| –                         | –                       | <b>B7221-E-T-P4S</b>   | 3,88              | <b>105</b> | 190 | 36 | 2,1 | 2,1            | –              | –              | –              | 25                      |
| –                         | –                       | <b>HCB7221-C-T-P4S</b> | 3,26              | <b>105</b> | 190 | 36 | 2,1 | 2,1            | –              | –              | –              | 15                      |
| –                         | –                       | <b>HCB7221-E-T-P4S</b> | 3,25              | <b>105</b> | 190 | 36 | 2,1 | 2,1            | –              | –              | –              | 25                      |

<sup>1)</sup> Explanation of short designations, see page 130.

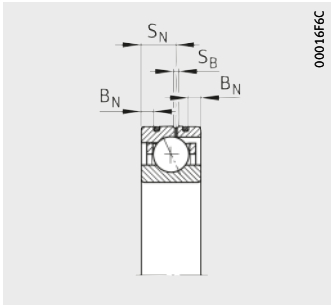
<sup>2)</sup> The limiting speeds in the dimension tables are based on elastically preloaded single bearings.

<sup>3)</sup> Explanation, see page 62.

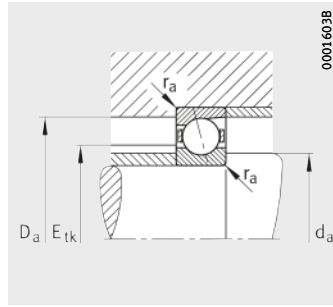
<sup>4)</sup> The bearings are also available with gap seals (type HSS, HCS, XCS or suffix 2RSD).  
Ordering examples: B7021-C-2RSD-T-P4S-UL and HSS7021-E-T-P4S-UL.

<sup>5)</sup> Minimal quantity oil lubrication.

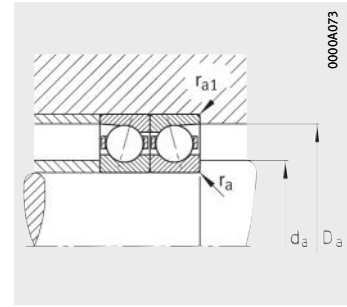
<sup>6)</sup> Ordering examples for Direct Lube design: HCB7021-EDLR-T-P4S-UL and HC7021-EDLR-T-P4S-UL.  
DLR only up to bore code 22.



Design DLR<sup>6)</sup>



Mounting dimensions



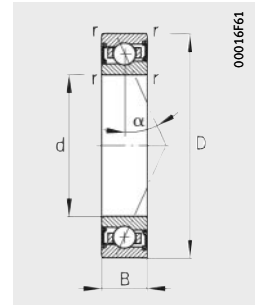
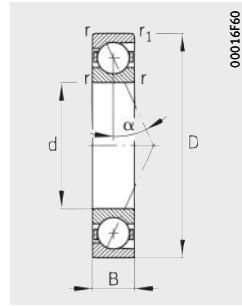
Mounting dimensions



| Mounting dimensions   |                       |                        |                         |                         | Basic load ratings           |                                | Limiting speeds <sup>2)</sup>              |   | Preload force <sup>3)</sup> |        |        | Lift-off force <sup>3)</sup> |        |        | Axial rigidity <sup>3)</sup> |           |           |
|-----------------------|-----------------------|------------------------|-------------------------|-------------------------|------------------------------|--------------------------------|--|---|-----------------------------|--------|--------|------------------------------|--------|--------|------------------------------|-----------|-----------|
| d <sub>a</sub><br>h12 | D <sub>a</sub><br>H12 | r <sub>a</sub><br>max. | r <sub>a1</sub><br>max. | E <sub>tk</sub><br>nom. | dyn.<br>C <sub>r</sub><br>kN | stat.<br>C <sub>0r</sub><br>kN | n <sub>G</sub> grease<br>min <sup>-1</sup> | n <sub>G</sub> oil <sup>5)</sup><br>min <sup>-1</sup> | F <sub>V</sub>              |        |        | K <sub>aE</sub>              |        |        | c <sub>a</sub>               |           |           |
|                       |                       |                        |                         |                         |                              |                                |  |   | L<br>N                      | M<br>N | H<br>N | L<br>N                       | M<br>N | H<br>N | L<br>N/μm                    | M<br>N/μm | H<br>N/μm |
| 112                   | 138                   | 0,6                    | 0,6                     | 121,2                   | 60                           | 45                             | 9 000                                      | 14 000  | 316                         | 1 040  | 2 101  | 968                          | 3 432  | 7 399  | 94,1                         | 159,8     | 227,5     |
| 112                   | 138                   | 0,6                    | 0,6                     | 121,2                   | 57                           | 42,5                           | 8 000                                      | 13 000  | 450                         | 1 616  | 3 417  | 1 305                        | 4 839  | 10 556 | 218,7                        | 353,4     | 478,9     |
| 112                   | 138                   | 0,6                    | 0,6                     | 121,2                   | 60                           | 43                             | 13 000                                     | 19 000  | 157                         | 564    | 1 185  | 466                          | 1 763  | 3 895  | 80                           | 134,2     | 187,9     |
| 112                   | 138                   | 0,6                    | 0,6                     | 121,2                   | 57                           | 41                             | 11 000                                     | 17 000  | 204                         | 850    | 1 876  | 584                          | 2 489  | 5 611  | 186,8                        | 311,4     | 420,5     |
| 112                   | 138                   | 0,6                    | 0,6                     | 121,2                   | 56                           | 40,5                           | 11 000                                     | 16 000  | 268                         | 805    | 1 609  | 782                          | 2 412  | 4 959  | 137,9                        | 208,6     | 276       |
| 112                   | 138                   | 0,6                    | 0,6                     | 121,2                   | 56                           | 39                             | 14 000                                     | 22 000  | 187                         | 560    | 1 121  | 540                          | 1 653  | 3 377  | 136,8                        | 204,2     | 246,9     |
| 112                   | 138                   | 0,6                    | 0,6                     | 121,7                   | 29                           | 24,8                           | 13 000                                     | 19 000  | 101                         | 302    | 603    | 299                          | 937    | 1 946  | 67,6                         | 105,3     | 143       |
| 112                   | 138                   | 0,6                    | 0,6                     | 121,7                   | 27,5                         | 23,4                           | 11 000                                     | 17 000  | 161                         | 483    | 966    | 463                          | 1 414  | 2 880  | 169,6                        | 251,7     | 326,8     |
| 112                   | 138                   | 0,6                    | 0,6                     | 121,7                   | 27,5                         | 22,4                           | 15 000                                     | 22 000  | 113                         | 338    | 676    | 323                          | 980    | 1 987  | 169,5                        | 249,5     | 321,3     |
| 112                   | 138                   | 0,6                    | 0,6                     | 121,7                   | 42                           | 22,4                           | 16 000                                     | 24 000  | 113                         | 338    | 676    | 323                          | 980    | 1 987  | 169,5                        | 249,5     | 321,3     |
| 116                   | 150                   | 2                      | 1                       | 125,8                   | 85                           | 61                             | 8 500                                      | 13 000  | 471                         | 1 511  | 3 027  | 1 447                        | 5 010  | 10 710 | 107                          | 180,5     | 256,48    |
| 116                   | 150                   | 2                      | 1                       | 125,8                   | 80                           | 58                             | 7 500                                      | 12 000  | 691                         | 2 377  | 4 959  | 2 010                        | 7 133  | 15 359 | 250,5                        | 399,1     | 538,9     |
| 116                   | 150                   | 2                      | 1                       | 125,8                   | 85                           | 58                             | 12 000                                     | 18 000  | 244                         | 836    | 1 732  | 725                          | 2 623  | 5 718  | 92,1                         | 152,5     | 212,8     |
| 116                   | 150                   | 2                      | 1                       | 125,8                   | 80                           | 55                             | 11 000                                     | 16 000  | 336                         | 1 285  | 2 768  | 966                          | 3 768  | 8 297  | 219                          | 354,7     | 475,5     |
| 116                   | 150                   | 2                      | 1                       | 125,8                   | 79                           | 54                             | 10 000                                     | 16 000  | 364                         | 1 092  | 2 184  | 1 065                        | 3 296  | 6 793  | 140,6                        | 213,9     | 284,6     |
| 116                   | 150                   | 2                      | 1                       | 125,8                   | 79                           | 52                             | 13 000                                     | 20 000  | 255                         | 764    | 1 529  | 738                          | 2 267  | 4 641  | 139,5                        | 209,1     | 274,4     |
| 116                   | 150                   | 2                      | 1                       | 127,9                   | 47,5                         | 36,5                           | 12 000                                     | 18 000  | 164                         | 492    | 985    | 489                          | 1 536  | 3 194  | 75                           | 117,3     | 159,7     |
| 116                   | 150                   | 2                      | 1                       | 127,9                   | 45                           | 34,5                           | 11 000                                     | 16 000  | 267                         | 802    | 1 604  | 770                          | 2 354  | 4 797  | 189                          | 280,9     | 365,4     |
| 116                   | 150                   | 2                      | 1                       | 127,9                   | 45                           | 33                             | 14 000                                     | 22 000  | 184                         | 552    | 1 104  | 527                          | 1 602  | 3 250  | 187,7                        | 276,5     | 356,5     |
| 116                   | 150                   | 2                      | 1                       | 127,9                   | 69                           | 33                             | 15 000                                     | 24 000  | 184                         | 552    | 1 104  | 527                          | 1 602  | 3 250  | 187,7                        | 276,5     | 356,5     |
| 120,5                 | 174,5                 | 2,1                    | 2,1                     | 139,9                   | 164                          | 104                            | 7 000                                      | 11 000  | 989                         | 3 069  | 6 072  | 3 060                        | 10 252 | 21 655 | 131                          | 219,1     | 310,5     |
| 120,5                 | 174,5                 | 2,1                    | 2,1                     | 139,9                   | 156                          | 99                             | 6 300                                      | 9 500   | 1 545                       | 5 006  | 10 249 | 4 508                        | 15 092 | 31 918 | 311,5                        | 487,7     | 655,6     |
| 120,5                 | 174,5                 | 2,1                    | 2,1                     | 139,9                   | 164                          | 99                             | 9 000                                      | 15 000  | 536                         | 1 733  | 3 524  | 1 603                        | 5 476  | 11 721 | 114,4                        | 186,1     | 258,4     |
| 120,5                 | 174,5                 | 2,1                    | 2,1                     | 139,9                   | 156                          | 95                             | 7 500                                      | 12 000  | 800                         | 2 742  | 5 723  | 2 303                        | 8 067  | 17 220 | 277,7                        | 434,3     | 558,7     |

# Spindle bearings

With large or small balls  
 Steel or ceramic balls  
 Steel or Cronidur rings  
 Open or sealed  
 Design DLR



**Dimension table** (continued) · Dimensions in mm

| Designation <sup>1)</sup> |                         |                        | Mass<br>m<br>≈ kg | Dimensions |     |    |      |                |                |                |                | Contact angle<br>α<br>° |
|---------------------------|-------------------------|------------------------|-------------------|------------|-----|----|------|----------------|----------------|----------------|----------------|-------------------------|
| Series 719 <sup>4)</sup>  | Series 70 <sup>4)</sup> | Series 72              |                   | d          | D   | B  | r    | r <sub>1</sub> | B <sub>N</sub> | S <sub>N</sub> | S <sub>B</sub> |                         |
|                           |                         |                        |                   |            |     |    | min. |                |                |                |                |                         |
| <b>B71922-C-T-P4S</b>     | –                       | –                      | 0,834             | <b>110</b> | 150 | 20 | 1,1  | 1,1            | –              | –              | –              | 15                      |
| <b>B71922-E-T-P4S</b>     | –                       | –                      | 0,832             | <b>110</b> | 150 | 20 | 1,1  | 1,1            | –              | –              | –              | 25                      |
| <b>HCB71922-C-T-P4S</b>   | –                       | –                      | 0,715             | <b>110</b> | 150 | 20 | 1,1  | 1,1            | 4              | 12             | 2,2            | 15                      |
| <b>HCB71922-E-T-P4S</b>   | –                       | –                      | 0,713             | <b>110</b> | 150 | 20 | 1,1  | 1,1            | 4              | 12             | 2,2            | 25                      |
| <b>RS71922-D-T-P4S</b>    | –                       | –                      | 0,85              | <b>110</b> | 150 | 20 | 1,1  | 1,1            | –              | –              | –              | 20                      |
| <b>HCRS71922-D-T-P4S</b>  | –                       | –                      | 0,7               | <b>110</b> | 150 | 20 | 1,1  | 1,1            | 4              | 12             | 2,2            | 20                      |
| <b>HS71922-C-T-P4S</b>    | –                       | –                      | 0,913             | <b>110</b> | 150 | 20 | 1,1  | –              | –              | –              | –              | 15                      |
| <b>HS71922-E-T-P4S</b>    | –                       | –                      | 0,912             | <b>110</b> | 150 | 20 | 1,1  | –              | –              | –              | –              | 25                      |
| <b>HC71922-E-T-P4S</b>    | –                       | –                      | 0,945             | <b>110</b> | 150 | 20 | 1,1  | –              | 4              | 12             | 2,2            | 25                      |
| <b>XC71922-E-T-P4S</b>    | –                       | –                      | 0,945             | <b>110</b> | 150 | 20 | 1,1  | –              | 4              | 12             | 2,2            | 25                      |
| –                         | <b>B7022-C-T-P4S</b>    | –                      | 1,95              | <b>110</b> | 170 | 28 | 2    | 2              | –              | –              | –              | 15                      |
| –                         | <b>B7022-E-T-P4S</b>    | –                      | 1,95              | <b>110</b> | 170 | 28 | 2    | 2              | –              | –              | –              | 25                      |
| –                         | <b>HCB7022-C-T-P4S</b>  | –                      | 1,62              | <b>110</b> | 170 | 28 | 2    | 2              | 6              | 16,2           | 2,2            | 15                      |
| –                         | <b>HCB7022-E-T-P4S</b>  | –                      | 1,62              | <b>110</b> | 170 | 28 | 2    | 2              | 6              | 16,2           | 2,2            | 25                      |
| –                         | <b>RS7022-D-T-P4S</b>   | –                      | 1,94              | <b>110</b> | 170 | 28 | 2    | 2              | –              | –              | –              | 20                      |
| –                         | <b>HCRS7022-D-T-P4S</b> | –                      | 1,94              | <b>110</b> | 170 | 28 | 2    | 2              | 6              | 16,2           | 2,2            | 20                      |
| –                         | <b>HS7022-C-T-P4S</b>   | –                      | 2,17              | <b>110</b> | 170 | 28 | 2    | –              | –              | –              | –              | 15                      |
| –                         | <b>HS7022-E-T-P4S</b>   | –                      | 2,17              | <b>110</b> | 170 | 28 | 2    | –              | –              | –              | –              | 25                      |
| –                         | <b>HC7022-E-T-P4S</b>   | –                      | 2,21              | <b>110</b> | 170 | 28 | 2    | –              | 6              | 16,2           | 2,2            | 25                      |
| –                         | <b>XC7022-E-T-P4S</b>   | –                      | 2,21              | <b>110</b> | 170 | 28 | 2    | –              | 6              | 16,2           | 2,2            | 25                      |
| –                         | –                       | <b>B7222-C-T-P4S</b>   | 4,6               | <b>110</b> | 200 | 38 | 2,1  | 2,1            | –              | –              | –              | 15                      |
| –                         | –                       | <b>B7222-E-T-P4S</b>   | 4,59              | <b>110</b> | 200 | 38 | 2,1  | 2,1            | –              | –              | –              | 25                      |
| –                         | –                       | <b>HCB7222-C-T-P4S</b> | 3,97              | <b>110</b> | 200 | 38 | 2,1  | 2,1            | –              | –              | –              | 15                      |
| –                         | –                       | <b>HCB7222-E-T-P4S</b> | 3,96              | <b>110</b> | 200 | 38 | 2,1  | 2,1            | –              | –              | –              | 25                      |

<sup>1)</sup> Explanation of short designations, see page 130.

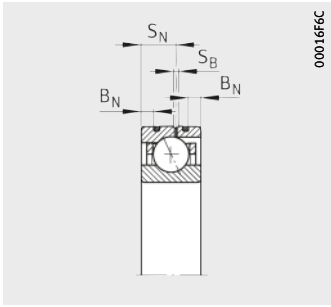
<sup>2)</sup> The limiting speeds in the dimension tables are based on elastically preloaded single bearings.

<sup>3)</sup> Explanation, see page 62.

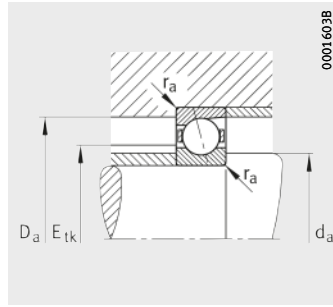
<sup>4)</sup> The bearings are also available with gap seals (type HSS, HCS, XCS or suffix 2RSD).  
 Ordering examples: B7022-C-2RSD-T-P4S-UL and HSS7022-E-T-P4S-UL.

<sup>5)</sup> Minimal quantity oil lubrication.

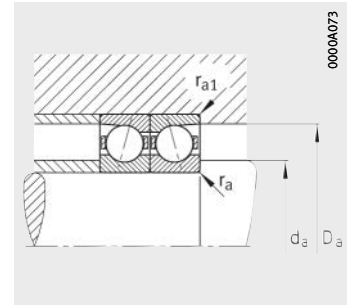
<sup>6)</sup> Ordering examples for Direct Lube design: HCB7022-EDLR-T-P4S-UL and HC7022-EDLR-T-P4S-UL.  
 DLR only up to bore code 22.



Design DLR<sup>6)</sup>



Mounting dimensions



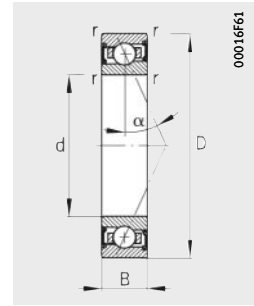
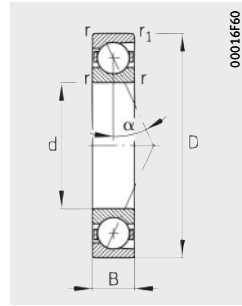
Mounting dimensions



| Mounting dimensions   |                       |                |                 |                 | Basic load ratings     |                          | Limiting speeds <sup>2)</sup> |                                  | Preload force <sup>3)</sup><br>F <sub>V</sub> |       |        | Lift-off force <sup>3)</sup><br>K <sub>aE</sub> |        |        | Axial rigidity <sup>3)</sup><br>c <sub>a</sub> |       |        |
|-----------------------|-----------------------|----------------|-----------------|-----------------|------------------------|--------------------------|-------------------------------|----------------------------------|---|-------|--------|---|--------|--------|--|-------|--------|
| d <sub>a</sub><br>h12 | D <sub>a</sub><br>H12 | r <sub>a</sub> | r <sub>a1</sub> | E <sub>tk</sub> | dyn.<br>C <sub>r</sub> | stat.<br>C <sub>0r</sub> | n <sub>G</sub> grease         | n <sub>G</sub> oil <sup>5)</sup> | L   | M     | H      | L   | M      | H      | L  | M     | H      |
|                       |                       | max.           |                 | nom.            | kN                     | kN                       | min <sup>-1</sup>             | min <sup>-1</sup>                | N   | N     | N      | N   | N      | N      | N/μm   | N/μm  | N/μm   |
| 117                   | 143                   | 0,6            | 0,6             | 126,2           | 61                     | 47                       | 8 500                         | 13 000                           | 314   | 1 038 | 2 102  | 961   | 3 415  | 7 373  | 96,1   | 163   | 231,8  |
| 117                   | 143                   | 0,6            | 0,6             | 126,2           | 58                     | 44,5                     | 8 000                         | 12 000                           | 455   | 1 642 | 3 475  | 1 321   | 4 913  | 10 722 | 225,3  | 364,1 | 493,4  |
| 117                   | 143                   | 0,6            | 0,6             | 126,2           | 61                     | 45                       | 12 000                        | 19 000                           | 158   | 570   | 1 199  | 468   | 1 777  | 3 931  | 82,1   | 137,8 | 192,8  |
| 117                   | 143                   | 0,6            | 0,6             | 126,2           | 58                     | 42,5                     | 11 000                        | 17 000                           | 208   | 871   | 1 923  | 596   | 2 547  | 5 747  | 192,9  | 322   | 434,9  |
| 117                   | 143                   | 0,6            | 0,6             | 126,2           | 57                     | 42,5                     | 10 000                        | 16 000                           | 273   | 819   | 1 638  | 795   | 2 454  | 5 043  | 142,3  | 215,1 | 284,5  |
| 117                   | 143                   | 0,6            | 0,6             | 126,2           | 57                     | 40,5                     | 13 000                        | 20 000                           | 192   | 575   | 1 150  | 553   | 1 695  | 3 462  | 141,5  | 211,2 | 255,2  |
| 117                   | 143                   | 0,6            | 0,6             | 126,4           | 34                     | 28,5                     | 12 000                        | 19 000                           | 116   | 347   | 693    | 344   | 1 077  | 2 238  | 70,6   | 109,9 | 149,3  |
| 117                   | 143                   | 0,6            | 0,6             | 126,4           | 32                     | 27                       | 11 000                        | 17 000                           | 187   | 561   | 1 121  | 538   | 1 642  | 3 344  | 177,7  | 263,7 | 342,5  |
| 117                   | 143                   | 0,6            | 0,6             | 126,4           | 32                     | 26                       | 14 000                        | 22 000                           | 131   | 393   | 787    | 375   | 1 141  | 2 312  | 177,7  | 261,6 | 337    |
| 117                   | 143                   | 0,6            | 0,6             | 126,4           | 49                     | 26                       | 16 000                        | 24 000                           | 131   | 393   | 787    | 375   | 1 141  | 2 312  | 177,7  | 261,6 | 337    |
| 121                   | 159                   | 2              | 1               | 133,3           | 112                    | 77                       | 8 000                         | 12 000                           | 643   | 2 033 | 4 052  | 1 981   | 6 757  | 14 370 | 118,8  | 199,6 | 283,13 |
| 121                   | 159                   | 2              | 1               | 133,3           | 106                    | 73                       | 7 500                         | 12 000                           | 968   | 3 242 | 6 709  | 2 820   | 9 745  | 20 814 | 280,1  | 442,5 | 596,2  |
| 121                   | 159                   | 2              | 1               | 133,3           | 112                    | 74                       | 12 000                        | 18 000                           | 337   | 1 126 | 2 314  | 1 004   | 3 540  | 7 655  | 102,6  | 168,5 | 234,4  |
| 121                   | 159                   | 2              | 1               | 133,3           | 106                    | 70                       | 11 000                        | 16 000                           | 490   | 1 779 | 3 778  | 1 409   | 5 224  | 11 341 | 248  | 395,1 | 527,4  |
| 121                   | 159                   | 2              | 1               | 133,3           | 105                    | 71                       | 9 500                         | 15 000                           | 491   | 1 474 | 2 948  | 1 439   | 4 455  | 9 185  | 155,2  | 236,3 | 314,6  |
| 121                   | 159                   | 2              | 1               | 133,3           | 105                    | 68                       | 12 000                        | 19 000                           | 334   | 1 003 | 2 007  | 969   | 2 975  | 6 092  | 152,3  | 228,3 | 299,6  |
| 121                   | 159                   | 2              | 1               | 135,4           | 48                     | 38                       | 12 000                        | 18 000                           | 168   | 503   | 1 005  | 499   | 1 566  | 3 257  | 77,2   | 120,5 | 164,1  |
| 121                   | 159                   | 2              | 1               | 135,4           | 45,5                   | 35,5                     | 11 000                        | 16 000                           | 267   | 802   | 1 604  | 770   | 2 352  | 4 792  | 193  | 286,7 | 372,8  |
| 121                   | 159                   | 2              | 1               | 135,4           | 46,5                   | 34                       | 13 000                        | 20 000                           | 187   | 561   | 1 121  | 535   | 1 627  | 3 299  | 192,8  | 283,9 | 366    |
| 121                   | 159                   | 2              | 1               | 135,4           | 69                     | 34                       | 14 000                        | 22 000                           | 187   | 561   | 1 121  | 535   | 1 627  | 3 299  | 192,8  | 283,9 | 366    |
| 126,5                 | 183,5                 | 2,1            | 2,1             | 147,4           | 164                    | 105                      | 6 700                         | 10 000                           | 989   | 3 069 | 6 072  | 3 060   | 10 252 | 21 655 | 131  | 219,1 | 310,5  |
| 126,5                 | 183,5                 | 2,1            | 2,1             | 147,4           | 156                    | 100                      | 6 000                         | 9 000                            | 1 512   | 4 905 | 10 048 | 4 410   | 14 777 | 31 257 | 309,1  | 483,8 | 650,1  |
| 126,5                 | 183,5                 | 2,1            | 2,1             | 147,4           | 164                    | 101                      | 8 500                         | 14 000                           | 536   | 1 733 | 3 524  | 1 603   | 5 476  | 11 721 | 114,4  | 186,1 | 258,4  |
| 126,5                 | 183,5                 | 2,1            | 2,1             | 147,4           | 156                    | 96                       | 7 000                         | 10 000                           | 800   | 2 742 | 5 723  | 2 303   | 8 067  | 17 220 | 277,7  | 434,3 | 558,7  |

# Spindle bearings

With large or small balls  
 Steel or ceramic balls  
 Steel or Cronidur rings  
 Open or sealed



**Dimension table** (continued) · Dimensions in mm

| Designation <sup>1)</sup> |                         |                        | Mass<br>m<br>≈ kg | Dimensions |     |    |     |                | Contact<br>angle<br>α<br>° | Mounting<br>dimensions |                       |
|---------------------------|-------------------------|------------------------|-------------------|------------|-----|----|-----|----------------|----------------------------|------------------------|-----------------------|
| Series 719 <sup>4)</sup>  | Series 70 <sup>4)</sup> | Series 72              |                   | d          | D   | B  | r   | r <sub>1</sub> |                            | d <sub>a</sub><br>h12  | D <sub>a</sub><br>H12 |
|                           |                         |                        |                   |            |     |    |     |                |                            |                        |                       |
|                           |                         |                        |                   |            |     |    |     | min.           |                            |                        |                       |
| <b>B71924-C-T-P4S</b>     | –                       | –                      | 1,16              | <b>120</b> | 165 | 22 | 1,1 | 1,1            | 15                         | 128                    | 157                   |
| <b>B71924-E-T-P4S</b>     | –                       | –                      | 1,16              | <b>120</b> | 165 | 22 | 1,1 | 1,1            | 25                         | 128                    | 157                   |
| <b>HCB71924-C-T-P4S</b>   | –                       | –                      | 0,972             | <b>120</b> | 165 | 22 | 1,1 | 1,1            | 15                         | 128                    | 157                   |
| <b>HCB71924-E-T-P4S</b>   | –                       | –                      | 0,969             | <b>120</b> | 165 | 22 | 1,1 | 1,1            | 25                         | 128                    | 157                   |
| <b>RS71924-D-T-P4S</b>    | –                       | –                      | 1,16              | <b>120</b> | 165 | 22 | 1,1 | 1,1            | 20                         | 128                    | 157                   |
| <b>HCRS71924-D-T-P4S</b>  | –                       | –                      | 0,97              | <b>120</b> | 165 | 22 | 1,1 | 1,1            | 20                         | 128                    | 157                   |
| <b>HS71924-C-T-P4S</b>    | –                       | –                      | 1,29              | <b>120</b> | 165 | 22 | 1,1 | –              | 15                         | 128                    | 157                   |
| <b>HS71924-E-T-P4S</b>    | –                       | –                      | 1,29              | <b>120</b> | 165 | 22 | 1,1 | –              | 25                         | 128                    | 157                   |
| <b>HC71924-E-T-P4S</b>    | –                       | –                      | 1,31              | <b>120</b> | 165 | 22 | 1,1 | –              | 25                         | 128                    | 157                   |
| <b>XC71924-E-T-P4S</b>    | –                       | –                      | 1,31              | <b>120</b> | 165 | 22 | 1,1 | –              | 25                         | 128                    | 157                   |
| –                         | <b>B7024-C-T-P4S</b>    | –                      | 2,08              | <b>120</b> | 180 | 28 | 2   | 2              | 15                         | 131                    | 169                   |
| –                         | <b>B7024-E-T-P4S</b>    | –                      | 2,07              | <b>120</b> | 180 | 28 | 2   | 2              | 25                         | 131                    | 169                   |
| –                         | <b>HCB7024-C-T-P4S</b>  | –                      | 1,74              | <b>120</b> | 180 | 28 | 2   | 2              | 15                         | 131                    | 169                   |
| –                         | <b>HCB7024-E-T-P4S</b>  | –                      | 1,73              | <b>120</b> | 180 | 28 | 2   | 2              | 25                         | 131                    | 169                   |
| –                         | <b>RS7024-D-T-P4S</b>   | –                      | 2,05              | <b>120</b> | 180 | 28 | 2   | 2              | 20                         | 131                    | 169                   |
| –                         | <b>HCRS7024-D-T-P4S</b> | –                      | 2,05              | <b>120</b> | 180 | 28 | 2   | 2              | 20                         | 131                    | 169                   |
| –                         | <b>HS7024-C-T-P4S</b>   | –                      | 2,33              | <b>120</b> | 180 | 28 | 2   | –              | 15                         | 131                    | 169                   |
| –                         | <b>HS7024-E-T-P4S</b>   | –                      | 2,32              | <b>120</b> | 180 | 28 | 2   | –              | 25                         | 131                    | 169                   |
| –                         | <b>HC7024-E-T-P4S</b>   | –                      | 2,37              | <b>120</b> | 180 | 28 | 2   | –              | 25                         | 131                    | 169                   |
| –                         | <b>XC7024-E-T-P4S</b>   | –                      | 2,37              | <b>120</b> | 180 | 28 | 2   | –              | 25                         | 131                    | 169                   |
| –                         | –                       | <b>B7224-C-T-P4S</b>   | 5,3               | <b>120</b> | 215 | 40 | 2,1 | 2,1            | 15                         | 140                    | 195                   |
| –                         | –                       | <b>B7224-E-T-P4S</b>   | 5,28              | <b>120</b> | 215 | 40 | 2,1 | 2,1            | 25                         | 140                    | 195                   |
| –                         | –                       | <b>HCB7224-C-T-P4S</b> | 4,2               | <b>120</b> | 215 | 40 | 2,1 | 2,1            | 15                         | 140                    | 195                   |
| –                         | –                       | <b>HCB7224-E-T-P4S</b> | 4,18              | <b>120</b> | 215 | 40 | 2,1 | 2,1            | 25                         | 140                    | 195                   |

<sup>1)</sup> Explanation of short designations, see page 130.

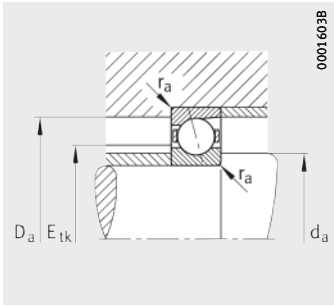
<sup>2)</sup> The limiting speeds in the dimension tables are based on elastically preloaded single bearings.

<sup>3)</sup> Explanation, see page 62.

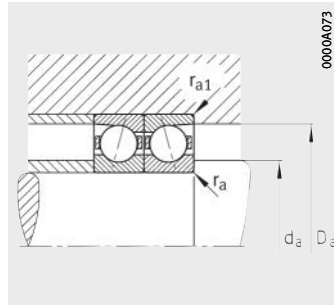
<sup>4)</sup> The bearings are also available with gap seals (type HSS, HCS, XCS or suffix 2RSD).  
 Ordering examples: B7024-C-2RSD-T-P4S-UL and HSS7024-E-T-P4S-UL.

<sup>5)</sup> Minimal quantity oil lubrication.





Mounting dimensions



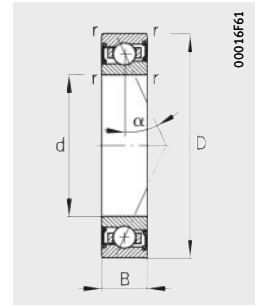
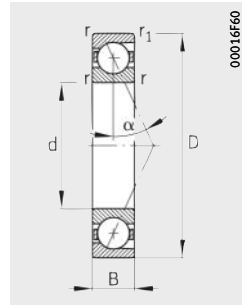
Mounting dimensions



|                |                 |                 | Basic load ratings     |                          | Limiting speeds <sup>2)</sup> |                                  | Preload force <sup>3)</sup><br>F <sub>V</sub> |       |        | Lift-off force <sup>3)</sup><br>K <sub>aE</sub> |        |        | Axial rigidity <sup>3)</sup><br>c <sub>a</sub> |       |        |
|----------------|-----------------|-----------------|------------------------|--------------------------|-------------------------------|----------------------------------|---|-------|--------|---|--------|--------|--|-------|--------|
| r <sub>a</sub> | r <sub>a1</sub> | E <sub>tk</sub> | dyn.<br>C <sub>r</sub> | stat.<br>C <sub>0r</sub> | n <sub>G</sub> grease         | n <sub>G</sub> oil <sup>5)</sup> | L   | M     | H      | L   | M      | H      | L  | M     | H      |
| max.           |                 | nom.            | kN                     | kN                       | min <sup>-1</sup>             | min <sup>-1</sup>                | N   | N     | N      | N   | N      | N      | N/μm   | N/μm  | N/μm   |
| 0,6            | 0,6             | 138,2           | 76                     | 59                       | 8 000                         | 12 000                           | 405   | 1 321 | 2 665  | 1 239   | 4 349  | 9 350  | 108,9  | 183,8 | 261,1  |
| 0,6            | 0,6             | 138,2           | 72                     | 56                       | 7 000                         | 11 000                           | 587   | 2 073 | 4 361  | 1 705   | 6 203  | 13 450 | 255,1  | 409,3 | 553,1  |
| 0,6            | 0,6             | 138,2           | 76                     | 57                       | 11 000                        | 17 000                           | 208   | 732   | 1 530  | 616   | 2 286  | 5 019  | 93,7   | 156   | 217,8  |
| 0,6            | 0,6             | 138,2           | 72                     | 54                       | 10 000                        | 15 000                           | 274   | 1 101 | 2 407  | 785   | 3 223  | 7 191  | 220,1  | 362,1 | 487,1  |
| 0,6            | 0,6             | 138,2           | 71                     | 54                       | 9 500                         | 14 000                           | 340   | 1 020 | 2 041  | 990   | 3 055  | 6 277  | 159,2  | 240,5 | 318    |
| 0,6            | 0,6             | 138,2           | 71                     | 52                       | 12 000                        | 19 000                           | 235   | 704   | 1 408  | 678   | 2 074  | 4 235  | 157,4  | 234,7 | 285,6  |
| 0,6            | 0,6             | 138,9           | 35,5                   | 32                       | 11 000                        | 17 000                           | 122   | 367   | 734    | 363   | 1 137  | 2 362  | 76,8   | 119,4 | 162    |
| 0,6            | 0,6             | 138,9           | 33,5                   | 30                       | 10 000                        | 15 000                           | 196   | 587   | 1 173  | 562   | 1 716  | 3 492  | 193  | 286,1 | 371,2  |
| 0,6            | 0,6             | 138,9           | 33,5                   | 29                       | 13 000                        | 20 000                           | 136   | 407   | 814    | 388   | 1 179  | 2 389  | 192,3  | 282,9 | 364,1  |
| 0,6            | 0,6             | 138,9           | 51                     | 29                       | 14 000                        | 22 000                           | 136   | 407   | 814    | 388   | 1 179  | 2 389  | 192,3  | 282,9 | 364,1  |
| 2              | 1               | 143,3           | 115                    | 82                       | 7 500                         | 12 000                           | 653   | 2 069 | 4 129  | 2 008   | 6 858  | 14 599 | 123  | 206,4 | 292,62 |
| 2              | 1               | 143,3           | 109                    | 78                       | 6 700                         | 10 000                           | 983   | 3 298 | 6 830  | 2 860   | 9 902  | 21 158 | 290,4  | 458,9 | 617,9  |
| 2              | 1               | 143,3           | 115                    | 78                       | 10 000                        | 16 000                           | 350   | 1 170 | 2 406  | 1 042   | 3 677  | 7 953  | 107,3  | 176,1 | 245    |
| 2              | 1               | 143,3           | 109                    | 75                       | 9 500                         | 14 000                           | 496   | 1 810 | 3 849  | 1 427   | 5 313  | 11 543 | 257,2  | 410   | 547,2  |
| 2              | 1               | 143,3           | 108                    | 75                       | 9 000                         | 14 000                           | 501   | 1 502 | 3 003  | 1 464   | 4 533  | 9 341  | 161,1  | 245,1 | 326    |
| 2              | 1               | 143,3           | 108                    | 72                       | 11 000                        | 18 000                           | 341   | 1 024 | 2 048  | 988   | 3 034  | 6 209  | 158,3  | 237,1 | 311    |
| 2              | 1               | 145,4           | 49,5                   | 40,5                     | 10 000                        | 16 000                           | 171   | 513   | 1 025  | 508   | 1 594  | 3 313  | 80,8   | 126   | 171,3  |
| 2              | 1               | 145,4           | 46,5                   | 38,5                     | 9 500                         | 14 000                           | 276   | 828   | 1 656  | 795   | 2 426  | 4 942  | 203,3  | 301,8 | 392,2  |
| 2              | 1               | 145,4           | 46,5                   | 36,5                     | 12 000                        | 19 000                           | 193   | 578   | 1 156  | 552   | 1 676  | 3 398  | 202,9  | 298,7 | 384,9  |
| 2              | 1               | 145,4           | 71                     | 36,5                     | 13 000                        | 20 000                           | 193   | 578   | 1 156  | 552   | 1 676  | 3 398  | 202,9  | 298,7 | 384,9  |
| 2,1            | 2,1             | 158             | 205                    | 138                      | 6 000                         | 9 000                            | 1 259   | 3 882 | 7 683  | 3 878   | 12 884 | 27 179 | 139  | 230,8 | 326    |
| 2,1            | 2,1             | 158             | 196                    | 132                      | 5 300                         | 8 000                            | 1 989   | 6 365 | 12 984 | 5 797   | 19 139 | 40 275 | 333,3  | 518,3 | 694,2  |
| 2,1            | 2,1             | 158             | 205                    | 132                      | 7 500                         | 12 000                           | 688   | 2 196 | 4 452  | 2 051   | 6 906  | 14 713 | 122  | 196,8 | 272,1  |
| 2,1            | 2,1             | 158             | 196                    | 126                      | 6 700                         | 9 500                            | 1 055   | 3 535 | 7 327  | 3 037   | 10 386 | 21 994 | 300  | 464,7 | 598,7  |

# Spindle bearings

With large or small balls  
 Steel or ceramic balls  
 Steel or Cronidur rings  
 Open or sealed



**Dimension table** (continued) · Dimensions in mm

| Designation <sup>1)</sup> |                         |                        | Mass<br>m<br>≈ kg | Dimensions |     |    |      |                | Contact<br>angle<br>$\alpha$<br>° | Mounting<br>dimensions |                       |
|---------------------------|-------------------------|------------------------|-------------------|------------|-----|----|------|----------------|-----------------------------------|------------------------|-----------------------|
| Series 719 <sup>4)</sup>  | Series 70 <sup>4)</sup> | Series 72              |                   | d          | D   | B  | r    | r <sub>1</sub> |                                   | d <sub>a</sub><br>h12  | D <sub>a</sub><br>H12 |
|                           |                         |                        |                   |            |     |    | min. |                |                                   |                        |                       |
| <b>B71926-C-T-P4S</b>     | –                       | –                      | 1,52              | <b>130</b> | 180 | 24 | 1,5  | 1,5            | 15                                | 139                    | 171                   |
| <b>B71926-E-T-P4S</b>     | –                       | –                      | 1,51              | <b>130</b> | 180 | 24 | 1,5  | 1,5            | 25                                | 139                    | 171                   |
| <b>HCB71926-C-T-P4S</b>   | –                       | –                      | 1,34              | <b>130</b> | 180 | 24 | 1,5  | 1,5            | 15                                | 139                    | 171                   |
| <b>HCB71926-E-T-P4S</b>   | –                       | –                      | 1,33              | <b>130</b> | 180 | 24 | 1,5  | 1,5            | 25                                | 139                    | 171                   |
| <b>RS71926-D-T-P4S</b>    | –                       | –                      | 1,52              | <b>130</b> | 180 | 24 | 1,5  | 1,5            | 20                                | 139                    | 171                   |
| <b>HCRS71926-D-T-P4S</b>  | –                       | –                      | 1,34              | <b>130</b> | 180 | 24 | 1,5  | 1,5            | 20                                | 139                    | 171                   |
| <b>HS71926-C-T-P4S</b>    | –                       | –                      | 1,71              | <b>130</b> | 180 | 24 | 1,5  | –              | 15                                | 139                    | 171                   |
| <b>HS71926-E-T-P4S</b>    | –                       | –                      | 1,71              | <b>130</b> | 180 | 24 | 1,5  | –              | 25                                | 139                    | 171                   |
| <b>HC71926-E-T-P4S</b>    | –                       | –                      | 1,76              | <b>130</b> | 180 | 24 | 1,5  | –              | 25                                | 139                    | 171                   |
| <b>XC71926-E-T-P4S</b>    | –                       | –                      | 1,76              | <b>130</b> | 180 | 24 | 1,5  | –              | 25                                | 139                    | 171                   |
| –                         | <b>B7026-C-T-P4S</b>    | –                      | 3,16              | <b>130</b> | 200 | 33 | 2    | 2              | 15                                | 142                    | 189                   |
| –                         | <b>B7026-E-T-P4S</b>    | –                      | 3,15              | <b>130</b> | 200 | 33 | 2    | 2              | 25                                | 142                    | 189                   |
| –                         | <b>HCB7026-C-T-P4S</b>  | –                      | 2,63              | <b>130</b> | 200 | 33 | 2    | 2              | 15                                | 142                    | 189                   |
| –                         | <b>HCB7026-E-T-P4S</b>  | –                      | 2,61              | <b>130</b> | 200 | 33 | 2    | 2              | 25                                | 142                    | 189                   |
| –                         | <b>RS7026-D-T-P4S</b>   | –                      | 3,16              | <b>130</b> | 200 | 33 | 2    | 2              | 20                                | 142                    | 189                   |
| –                         | <b>HCRS7026-D-T-P4S</b> | –                      | 3,16              | <b>130</b> | 200 | 33 | 2    | 2              | 20                                | 142                    | 189                   |
| –                         | <b>HS7026-C-T-P4S</b>   | –                      | 3,52              | <b>130</b> | 200 | 33 | 2    | –              | 15                                | 142                    | 189                   |
| –                         | <b>HS7026-E-T-P4S</b>   | –                      | 3,51              | <b>130</b> | 200 | 33 | 2    | –              | 25                                | 142                    | 189                   |
| –                         | <b>HC7026-E-T-P4S</b>   | –                      | 3,57              | <b>130</b> | 200 | 33 | 2    | –              | 25                                | 142                    | 189                   |
| –                         | <b>XC7026-E-T-P4S</b>   | –                      | 3,57              | <b>130</b> | 200 | 33 | 2    | –              | 25                                | 142                    | 189                   |
| –                         | –                       | <b>B7226-C-T-P4S</b>   | 6,11              | <b>130</b> | 230 | 40 | 3    | 3              | 15                                | 148                    | 211,5                 |
| –                         | –                       | <b>B7226-E-T-P4S</b>   | 6,09              | <b>130</b> | 230 | 40 | 3    | 3              | 25                                | 148                    | 211,5                 |
| –                         | –                       | <b>HCB7226-C-T-P4S</b> | 4,94              | <b>130</b> | 230 | 40 | 3    | 3              | 15                                | 148                    | 211,5                 |
| –                         | –                       | <b>HCB7226-E-T-P4S</b> | 4,92              | <b>130</b> | 230 | 40 | 3    | 3              | 25                                | 148                    | 211,5                 |

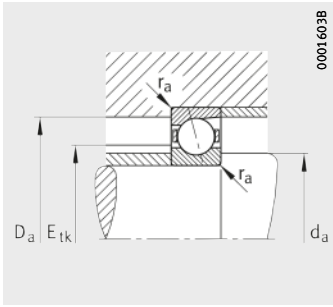
<sup>1)</sup> Explanation of short designations, see page 130.

<sup>2)</sup> The limiting speeds in the dimension tables are based on elastically preloaded single bearings.

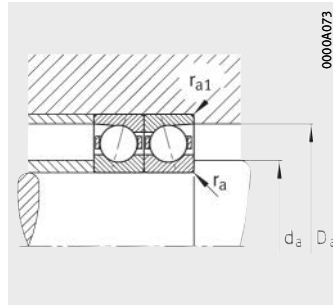
<sup>3)</sup> Explanation, see page 62.

<sup>4)</sup> The bearings are also available with gap seals (type HSS, HCS, XCS or suffix 2RSD).  
 Ordering examples: B7026-C-2RSD-T-P4S-UL and HSS7026-E-T-P4S-UL.

<sup>5)</sup> Minimal quantity oil lubrication.



Mounting dimensions



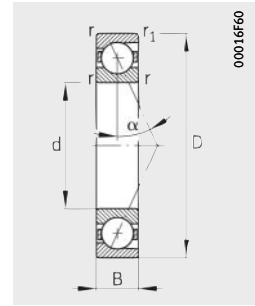
Mounting dimensions



|                |                 |                 | Basic load ratings     |                          | Limiting speeds <sup>2)</sup> |                                  | Preload force <sup>3)</sup><br>F <sub>V</sub> |       |        | Lift-off force <sup>3)</sup><br>K <sub>aE</sub> |        |        | Axial rigidity <sup>3)</sup><br>c <sub>a</sub> |       |       |
|----------------|-----------------|-----------------|------------------------|--------------------------|-------------------------------|----------------------------------|---|-------|--------|---|--------|--------|--|-------|-------|
| r <sub>a</sub> | r <sub>a1</sub> | E <sub>tk</sub> | dyn.<br>C <sub>r</sub> | stat.<br>C <sub>0r</sub> | n <sub>G</sub> grease         | n <sub>G</sub> oil <sup>5)</sup> | L   | M     | H      | L   | M      | H      | L  | M     | H     |
| max.           |                 | nom.            | kN                     | kN                       | min <sup>-1</sup>             | min <sup>-1</sup>                | N   | N     | N      | N   | N      | N      | N/μm   | N/μm  | N/μm  |
| 0,6            | 0,6             | 150,2           | 90                     | 70                       | 7 000                         | 11 000                           | 486   | 1 571 | 3 160  | 1 488   | 5 171  | 11 084 | 116,9  | 196,6 | 278,7 |
| 0,6            | 0,6             | 150,2           | 85                     | 67                       | 6 700                         | 10 000                           | 711   | 2 466 | 5 161  | 2 064   | 7 379  | 15 916 | 274,5  | 437,6 | 590,2 |
| 0,6            | 0,6             | 150,2           | 90                     | 68                       | 10 000                        | 15 000                           | 253   | 875   | 1 819  | 750   | 2 732  | 5 967  | 101,1  | 167,2 | 232,9 |
| 0,6            | 0,6             | 150,2           | 46,5                   | 28,5                     | 9 000                         | 14 000                           | 346   | 1 342 | 2 904  | 993   | 3 929  | 8 680  | 240,4  | 390,6 | 523,7 |
| 0,6            | 0,6             | 150,2           | 84                     | 63                       | 8 500                         | 13 000                           | 407   | 1 221 | 2 443  | 1 186   | 3 658  | 7 517  | 170,6  | 257,8 | 340,9 |
| 0,6            | 0,6             | 150,2           | 84                     | 60                       | 11 000                        | 17 000                           | 280   | 841   | 1 681  | 809   | 2 477  | 5 058  | 168,5  | 251,3 | 308,2 |
| 0,6            | -               | 151             | 40,5                   | 36,5                     | 10 000                        | 16 000                           | 139   | 417   | 834    | 413   | 1 291  | 2 682  | 81,1   | 126   | 170,8 |
| 0,6            | -               | 151             | 38,5                   | 34,5                     | 9 000                         | 14 000                           | 224   | 673   | 1 346  | 645   | 1 968  | 4 004  | 204,5  | 303,1 | 393,3 |
| 0,6            | -               | 151             | 38,5                   | 33                       | 12 000                        | 18 000                           | 155   | 466   | 932    | 444   | 1 349  | 2 732  | 203,7  | 299,5 | 385,4 |
| 0,6            | -               | 151             | 59                     | 33                       | 13 000                        | 20 000                           | 155   | 466   | 932    | 444   | 1 349  | 2 732  | 203,7  | 299,5 | 385,4 |
| 2              | 1               | 157,2           | 149                    | 107                      | 6 700                         | 10 000                           | 850   | 2 669 | 5 314  | 2 616   | 8 846  | 18 773 | 137  | 228,8 | 323,9 |
| 2              | 1               | 157,2           | 141                    | 102                      | 6 000                         | 9 500                            | 1 312   | 4 328 | 8 915  | 3 820   | 13 001 | 27 627 | 326,2  | 512,3 | 688,5 |
| 2              | 1               | 157,2           | 149                    | 102                      | 9 500                         | 14 000                           | 464   | 1 524 | 3 119  | 1 381   | 4 791  | 10 306 | 120,2  | 196,1 | 272,2 |
| 2              | 1               | 157,2           | 141                    | 97                       | 8 500                         | 13 000                           | 679   | 2 399 | 5 054  | 1 953   | 7 044  | 15 161 | 291,2  | 459,4 | 611,1 |
| 2              | 1               | 157,2           | 138                    | 96                       | 8 000                         | 12 000                           | 637   | 1 911 | 3 822  | 1 863   | 5 765  | 11 878 | 177,8  | 270,3 | 359,4 |
| 2              | 1               | 157,2           | 138                    | 91                       | 10 000                        | 16 000                           | 446   | 1 338 | 2 675  | 1 291   | 3 965  | 8 116  | 176,4  | 264,3 | 346,7 |
| 2              | -               | 159,7           | 64                     | 53                       | 9 500                         | 15 000                           | 219   | 658   | 1 317  | 653   | 2 046  | 4 251  | 91,8   | 143   | 194,3 |
| 2              | -               | 159,7           | 60                     | 50                       | 8 500                         | 13 000                           | 357   | 1 070 | 2 139  | 1 026   | 3 133  | 6 381  | 231,4  | 343,5 | 446,3 |
| 2              | -               | 159,7           | 60                     | 48                       | 11 000                        | 17 000                           | 244   | 733   | 1 466  | 700   | 2 126  | 4 308  | 229,6  | 337,9 | 435,2 |
| 2              | -               | 159,7           | 92                     | 48                       | 12 000                        | 19 000                           | 244   | 733   | 1 466  | 700   | 2 126  | 4 308  | 229,6  | 337,9 | 435,2 |
| 2,5            | 2,5             | 170,5           | 215                    | 151                      | 5 600                         | 8 500                            | 1 306   | 4 034 | 7 993  | 4 018   | 13 354 | 28 189 | 147  | 243,7 | 343,9 |
| 2,5            | 2,5             | 170,5           | 205                    | 144                      | 5 000                         | 7 500                            | 2 065   | 6 617 | 13 506 | 6 015   | 19 876 | 41 831 | 353,1  | 548,7 | 734,5 |
| 2,5            | 2,5             | 170,5           | 215                    | 144                      | 7 000                         | 11 000                           | 716   | 2 288 | 4 642  | 2 132   | 7 184  | 15 307 | 129,2  | 208,3 | 287,8 |
| 2,5            | 2,5             | 170,5           | 205                    | 138                      | 6 000                         | 9 000                            | 1 098   | 3 687 | 7 648  | 3 160   | 10 826 | 22 934 | 318,1  | 492,9 | 634,6 |

# Spindle bearings

With large balls  
 Steel or ceramic balls  
 Steel rings  
 Open or sealed



**Dimension table** (continued) · Dimensions in mm

| Designation <sup>1)</sup>            |                                     |                        | Mass<br>m<br>≈ kg | Dimensions |     |    |     |                | Contact<br>angle<br>α<br>° | Mounting<br>dimensions |                       |
|--------------------------------------|-------------------------------------|------------------------|-------------------|------------|-----|----|-----|----------------|----------------------------|------------------------|-----------------------|
| Series 719                           | Series 70                           | Series 72              |                   | d          | D   | B  | r   | r <sub>1</sub> |                            | d <sub>a</sub><br>h12  | D <sub>a</sub><br>H12 |
| <b>B71928-C-T-P4S<sup>5)</sup></b>   | –                                   | –                      | 1,62              | <b>140</b> | 190 | 24 | 1,5 | 1,5            | 15                         | 149                    | 181                   |
| <b>B71928-E-T-P4S<sup>5)</sup></b>   | –                                   | –                      | 1,61              | <b>140</b> | 190 | 24 | 1,5 | 1,5            | 25                         | 149                    | 181                   |
| <b>HCB71928-C-T-P4S<sup>5)</sup></b> | –                                   | –                      | 1,42              | <b>140</b> | 190 | 24 | 1,5 | 1,5            | 15                         | 149                    | 181                   |
| <b>HCB71928-E-T-P4S<sup>5)</sup></b> | –                                   | –                      | 1,42              | <b>140</b> | 190 | 24 | 1,5 | 1,5            | 25                         | 149                    | 181                   |
| –                                    | <b>B7028-C-T-P4S<sup>5)</sup></b>   | –                      | 3,35              | <b>140</b> | 210 | 33 | 2   | 2              | 15                         | 152                    | 199                   |
| –                                    | <b>B7028-E-T-P4S<sup>5)</sup></b>   | –                      | 3,34              | <b>140</b> | 210 | 33 | 2   | 2              | 25                         | 152                    | 199                   |
| –                                    | <b>B7228-C-T-P4S</b>                | –                      | 7,88              | <b>140</b> | 250 | 42 | 3   | 3              | 15                         | 163                    | 226,5                 |
| –                                    | <b>B7228-E-T-P4S</b>                | –                      | 7,86              | <b>140</b> | 250 | 42 | 3   | 3              | 25                         | 163                    | 226,5                 |
| –                                    | <b>HCB7028-C-T-P4S<sup>5)</sup></b> | –                      | 2,79              | <b>140</b> | 210 | 33 | 2   | 2              | 15                         | 152                    | 199                   |
| –                                    | <b>HCB7028-E-T-P4S<sup>5)</sup></b> | –                      | 2,78              | <b>140</b> | 210 | 33 | 2   | 2              | 25                         | 152                    | 199                   |
| –                                    | –                                   | <b>HCB7228-C-T-P4S</b> | 6,62              | <b>140</b> | 250 | 42 | 3   | 3              | 15                         | 163                    | 226,5                 |
| –                                    | –                                   | <b>HCB7228-E-T-P4S</b> | 6,6               | <b>140</b> | 250 | 42 | 3   | 3              | 25                         | 163                    | 226,5                 |
| <b>B71930-C-T-P4S</b>                | –                                   | –                      | 2,5               | <b>150</b> | 210 | 28 | 2   | 1              | 15                         | 160                    | 199                   |
| <b>B71930-E-T-P4S</b>                | –                                   | –                      | 2,5               | <b>150</b> | 210 | 28 | 2   | 1              | 25                         | 160                    | 199                   |
| <b>HCB71930-C-T-P4S</b>              | –                                   | –                      | 2,09              | <b>150</b> | 210 | 28 | 2   | 1              | 15                         | 160                    | 199                   |
| <b>HCB71930-E-T-P4S</b>              | –                                   | –                      | 2,08              | <b>150</b> | 210 | 28 | 2   | 1              | 25                         | 160                    | 199                   |
| –                                    | <b>B7030-C-T-P4S</b>                | –                      | 4,04              | <b>150</b> | 225 | 35 | 2,1 | 2,1            | 15                         | 163                    | 213                   |
| –                                    | <b>B7030-E-T-P4S</b>                | –                      | 4,03              | <b>150</b> | 225 | 35 | 2,1 | 2,1            | 25                         | 163                    | 213                   |
| –                                    | <b>HCB7030-C-T-P4S</b>              | –                      | 3,25              | <b>150</b> | 225 | 35 | 2,1 | 2,1            | 15                         | 163                    | 213                   |
| –                                    | <b>HCB7030-E-T-P4S</b>              | –                      | 3,24              | <b>150</b> | 225 | 35 | 2,1 | 2,1            | 25                         | 163                    | 213                   |
| –                                    | –                                   | <b>B7230-C-T-P4S</b>   | 10,1              | <b>150</b> | 270 | 45 | 3   | 3              | 15                         | 178                    | 241,5                 |
| –                                    | –                                   | <b>B7230-E-T-P4S</b>   | 10,1              | <b>150</b> | 270 | 45 | 3   | 3              | 25                         | 178                    | 241,5                 |
| –                                    | –                                   | <b>HCB7230-C-T-P4S</b> | 8,82              | <b>150</b> | 270 | 45 | 3   | 3              | 15                         | 178                    | 241,5                 |
| –                                    | –                                   | <b>HCB7230-E-T-P4S</b> | 8,79              | <b>150</b> | 270 | 45 | 3   | 3              | 25                         | 178                    | 241,5                 |

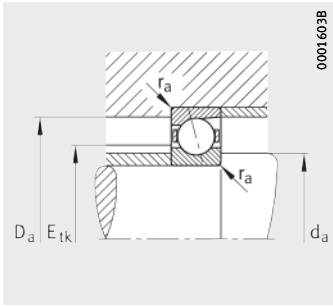
<sup>1)</sup> Explanation of short designations, see page 130.

<sup>2)</sup> The limiting speeds in the dimension tables are based on elastically preloaded single bearings.

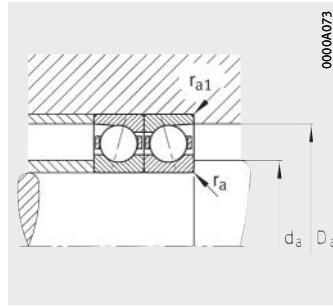
<sup>3)</sup> Explanation, see page 62.

<sup>4)</sup> Minimal quantity oil lubrication.

<sup>5)</sup> The bearings are also available with gap seals (type HSS, HCS, XCS or suffix 2RSD).  
 Ordering examples: B7028-C-2RSD-T-P4S-UL



Mounting dimensions



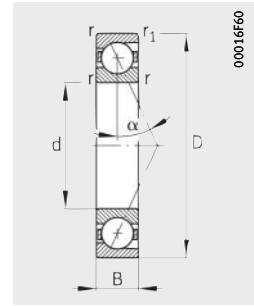
Mounting dimensions



|                |                 |                 | Basic load ratings     |                          | Limiting speeds <sup>2)</sup> |                                  | Preload force <sup>3)</sup><br>F <sub>V</sub> |       |        | Lift-off force <sup>3)</sup><br>K <sub>aE</sub> |        |        | Axial rigidity <sup>3)</sup><br>c <sub>a</sub> |       |        |
|----------------|-----------------|-----------------|------------------------|--------------------------|-------------------------------|----------------------------------|---|-------|--------|---|--------|--------|--|-------|--------|
| r <sub>a</sub> | r <sub>a1</sub> | E <sub>tk</sub> | dyn.<br>C <sub>r</sub> | stat.<br>C <sub>0r</sub> | n <sub>G</sub> grease         | n <sub>G</sub> oil <sup>4)</sup> | L   | M     | H      | L   | M      | H      | L  | M     | H      |
| max.           | nom.            | nom.            | kN                     | kN                       | min <sup>-1</sup>             | min <sup>-1</sup>                | N   | N     | N      | N   | N      | N      | N/μm   | N/μm  | N/μm   |
| 0,6            | 0,6             | 160,2           | 94                     | 77                       | 6 700                         | 10 000                           | 504   | 1 632 | 3 289  | 1 539   | 5 357  | 11 496 | 124,1  | 208,4 | 295,3  |
| 0,6            | 0,6             | 160,2           | 88                     | 72                       | 6 000                         | 9 500                            | 736   | 2 564 | 5 373  | 2 136   | 7 663  | 16 542 | 292  | 465,7 | 627,7  |
| 0,6            | 0,6             | 160,2           | 94                     | 74                       | 9 500                         | 14 000                           | 259   | 901   | 1 876  | 767   | 2 806  | 6 135  | 107  | 176,9 | 246,1  |
| 0,6            | 0,6             | 160,2           | 89                     | 70                       | 8 500                         | 13 000                           | 348   | 1 367 | 2 967  | 999   | 3 997  | 8 852  | 253,4  | 412,9 | 553,5  |
| 2              | 1               | 167,2           | 153                    | 114                      | 6 300                         | 10 000                           | 866   | 2 724 | 5 429  | 2 661   | 9 007  | 19 129 | 142  | 237   | 335,23 |
| 2              | 1               | 167,2           | 145                    | 108                      | 5 600                         | 9 000                            | 1 336   | 4 416 | 9 103  | 3 888   | 13 252 | 28 168 | 338,7  | 531,9 | 714,4  |
| 2,5            | 2,5             | 185,5           | 224                    | 164                      | 5 000                         | 7 500                            | 1 353   | 4 185 | 8 302  | 4 158   | 13 825 | 29 200 | 154,9  | 256,5 | 361,7  |
| 2,5            | 2,5             | 185,5           | 213                    | 157                      | 4 500                         | 6 700                            | 2 141   | 6 870 | 14 029 | 6 233   | 20 615 | 43 390 | 372,7  | 579   | 774,7  |
| 2              | 1               | 167,2           | 153                    | 109                      | 9 000                         | 14 000                           | 471   | 1 553 | 3 179  | 1 402   | 4 871  | 10 483 | 124,6  | 203,1 | 281,8  |
| 2              | 1               | 167,2           | 145                    | 103                      | 8 000                         | 12 000                           | 685   | 2 429 | 5 123  | 1 968   | 7 126  | 15 352 | 301,5  | 475,8 | 632,8  |
| 2,5            | 2,5             | 185,5           | 224                    | 157                      | 6 300                         | 9 500                            | 749   | 2 397 | 4 864  | 2 230   | 7 516  | 16 017 | 136,8  | 220,4 | 304,3  |
| 2,5            | 2,5             | 185,5           | 213                    | 150                      | 5 300                         | 8 000                            | 1 141   | 3 839 | 7 968  | 3 284   | 11 267 | 23 876 | 336,3  | 521,1 | 670,5  |
| 1              | 1               | 174,3           | 125                    | 101                      | 6 300                         | 9 500                            | 706   | 2 249 | 4 507  | 2 161   | 7 402  | 15 795 | 140,7  | 235,3 | 332,8  |
| 1              | 1               | 174,3           | 119                    | 95                       | 5 600                         | 8 500                            | 1 040   | 3 522 | 7 317  | 3 021   | 10 536 | 22 549 | 331,3  | 523,5 | 703,6  |
| 1              | 1               | 174,3           | 125                    | 96                       | 8 500                         | 13 000                           | 376   | 1 268 | 2 617  | 1 117   | 3 963  | 8 587  | 122,8  | 201,2 | 279,3  |
| 1              | 1               | 174,3           | 119                    | 91                       | 7 500                         | 12 000                           | 527   | 1 950 | 4 164  | 1 513   | 5 709  | 12 445 | 294,1  | 470,3 | 627,4  |
| 2,1            | 1               | 178,5           | 187                    | 137                      | 6 000                         | 9 000                            | 1 104   | 3 443 | 6 843  | 3 394   | 11 397 | 24 140 | 156,1  | 259,9 | 367,4  |
| 2,1            | 1               | 178,5           | 178                    | 130                      | 5 300                         | 8 000                            | 1 691   | 5 520 | 11 332 | 4 923   | 16 566 | 35 067 | 371  | 580   | 777,9  |
| 2,1            | 1               | 178,5           | 187                    | 131                      | 8 000                         | 13 000                           | 602   | 1 958 | 3 992  | 1 793   | 6 146  | 13 171 | 137,1  | 222,4 | 308,1  |
| 2,1            | 1               | 178,5           | 178                    | 125                      | 7 500                         | 11 000                           | 889   | 3 079 | 6 448  | 2 556   | 9 036  | 19 329 | 333,1  | 521,6 | 692    |
| 2,5            | 2,5             | 200,5           | 232                    | 178                      | 4 500                         | 6 700                            | 1 401   | 4 337 | 8 611  | 4 299   | 14 296 | 30 211 | 162,8  | 269,3 | 379,5  |
| 2,5            | 2,5             | 200,5           | 221                    | 169                      | 4 000                         | 6 000                            | 2 173   | 6 987 | 14 280 | 6 322   | 20 936 | 44 075 | 389,5  | 604,8 | 808,4  |
| 2,5            | 2,5             | 200,5           | 232                    | 170                      | 6 000                         | 8 500                            | 761   | 2 440 | 4 958  | 2 262   | 7 633  | 16 272 | 142,9  | 229,9 | 317    |
| 2,5            | 2,5             | 200,5           | 221                    | 162                      | 5 000                         | 7 500                            | 1 167   | 3 935 | 8 175  | 3 355   | 11 539 | 24 467 | 352,4  | 546,3 | 702,3  |

# Spindle bearings

With large balls  
Steel or ceramic balls  
Steel rings  
Open or sealed



**Dimension table** (continued) · Dimensions in mm

| Designation <sup>1)</sup>            |                        |                        | Mass<br>m<br>≈ kg | Dimensions |     |    |     |                | Contact<br>angle<br>α<br>° | Mounting<br>dimensions |                       |
|--------------------------------------|------------------------|------------------------|-------------------|------------|-----|----|-----|----------------|----------------------------|------------------------|-----------------------|
| Series 719                           | Series 70              | Series 72              |                   | d          | D   | B  | r   | r <sub>1</sub> |                            | d <sub>a</sub><br>h12  | D <sub>a</sub><br>H12 |
| <b>B71932-C-T-P4S<sup>5)</sup></b>   | –                      | –                      | 2,63              | <b>160</b> | 220 | 28 | 2   | 1              | 15                         | 170                    | 209                   |
| <b>B71932-E-T-P4S<sup>5)</sup></b>   | –                      | –                      | 2,62              | <b>160</b> | 220 | 28 | 2   | 1              | 25                         | 170                    | 209                   |
| <b>HCB71932-C-T-P4S<sup>5)</sup></b> | –                      | –                      | 2,21              | <b>160</b> | 220 | 28 | 2   | 1              | 15                         | 170                    | 209                   |
| <b>HCB71932-E-T-P4S<sup>5)</sup></b> | –                      | –                      | 2,2               | <b>160</b> | 220 | 28 | 2   | 1              | 25                         | 170                    | 209                   |
| –                                    | <b>B7032-C-T-P4S</b>   | –                      | 5,04              | <b>160</b> | 240 | 38 | 2,1 | 2,1            | 15                         | 174                    | 228                   |
| –                                    | <b>B7032-E-T-P4S</b>   | –                      | 5,01              | <b>160</b> | 240 | 38 | 2,1 | 2,1            | 25                         | 174                    | 228                   |
| –                                    | <b>B7232-C-T-P4S</b>   | –                      | 12,9              | <b>160</b> | 290 | 48 | 3   | 3              | 15                         | 191                    | 259                   |
| –                                    | <b>B7232-E-T-P4S</b>   | –                      | 12,9              | <b>160</b> | 290 | 48 | 3   | 3              | 25                         | 191                    | 259                   |
| –                                    | <b>HCB7032-C-T-P4S</b> | –                      | 4,2               | <b>160</b> | 240 | 38 | 2,1 | 2,1            | 15                         | 174                    | 228                   |
| –                                    | <b>HCB7032-E-T-P4S</b> | –                      | 4,18              | <b>160</b> | 240 | 38 | 2,1 | 2,1            | 25                         | 174                    | 228                   |
| –                                    | –                      | <b>HCB7232-C-T-P4S</b> | 11,4              | <b>160</b> | 290 | 48 | 3   | 3              | 15                         | 191                    | 259                   |
| –                                    | –                      | <b>HCB7232-E-T-P4S</b> | 11,4              | <b>160</b> | 290 | 48 | 3   | 3              | 25                         | 191                    | 259                   |
| <b>B71934-C-T-P4S</b>                | –                      | –                      | 2,79              | <b>170</b> | 230 | 28 | 2   | 1,5            | 15                         | 180                    | 219                   |
| <b>B71934-E-T-P4S</b>                | –                      | –                      | 2,78              | <b>170</b> | 230 | 28 | 2   | 1,5            | 25                         | 180                    | 219                   |
| <b>HCB71934-C-T-P4S</b>              | –                      | –                      | 2,33              | <b>170</b> | 230 | 28 | 2   | 1,5            | 15                         | 180                    | 219                   |
| <b>HCB71934-E-T-P4S</b>              | –                      | –                      | 2,32              | <b>170</b> | 230 | 28 | 2   | 1,5            | 25                         | 180                    | 219                   |
| –                                    | <b>B7034-C-T-P4S</b>   | –                      | 6,52              | <b>170</b> | 260 | 42 | 2,1 | 2,1            | 15                         | 185                    | 246                   |
| –                                    | <b>B7034-E-T-P4S</b>   | –                      | 6,49              | <b>170</b> | 260 | 42 | 2,1 | 2,1            | 25                         | 185                    | 246                   |
| –                                    | –                      | <b>B7234-C-T-P4S</b>   | 15,7              | <b>170</b> | 310 | 52 | 4   | 4              | 15                         | 205                    | 275                   |
| –                                    | –                      | <b>B7234-E-T-P4S</b>   | 15,6              | <b>170</b> | 310 | 52 | 4   | 4              | 25                         | 205                    | 275                   |
| <b>B71936-C-T-P4S</b>                | –                      | –                      | 4,14              | <b>180</b> | 250 | 33 | 2   | 1              | 15                         | 192                    | 238                   |
| <b>B71936-E-T-P4S</b>                | –                      | –                      | 4,12              | <b>180</b> | 250 | 33 | 2   | 1              | 25                         | 192                    | 238                   |
| <b>HCB71936-C-T-P4S</b>              | –                      | –                      | 3,45              | <b>180</b> | 250 | 33 | 2   | 1              | 15                         | 192                    | 238                   |
| <b>HCB71936-E-T-P4S</b>              | –                      | –                      | 3,43              | <b>180</b> | 250 | 33 | 2   | 1              | 25                         | 192                    | 238                   |
| –                                    | <b>B7036-C-T-P4S</b>   | –                      | 8,79              | <b>180</b> | 280 | 46 | 2,1 | 2,1            | 15                         | 196                    | 264                   |
| –                                    | <b>B7036-E-T-P4S</b>   | –                      | 8,76              | <b>180</b> | 280 | 46 | 2,1 | 2,1            | 25                         | 196                    | 264                   |
| –                                    | –                      | <b>B7236-C-T-P4S</b>   | 16,4              | <b>180</b> | 320 | 52 | 4   | 4              | 15                         | 213,5                  | 286,5                 |
| –                                    | –                      | <b>B7236-E-T-P4S</b>   | 16,3              | <b>180</b> | 320 | 52 | 4   | 4              | 25                         | 213,5                  | 286,5                 |

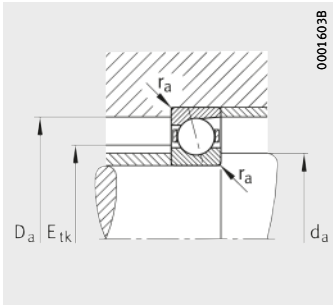
<sup>1)</sup> Explanation of short designations, see page 130.

<sup>2)</sup> The limiting speeds in the dimension tables are based on elastically preloaded single bearings.

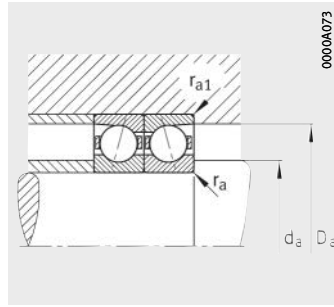
<sup>3)</sup> Explanation, see page 62.

<sup>4)</sup> Minimal quantity oil lubrication.

<sup>5)</sup> The bearings are also available with gap seals (type HSS, HCS, XCS or suffix 2RSD).  
Ordering examples: B7032-C-2RSD-T-P4S-UL.



Mounting dimensions



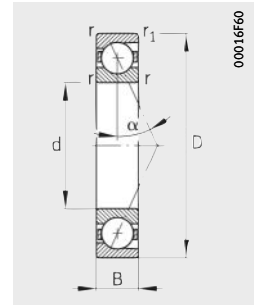
Mounting dimensions



|                |                 |                 | Basic load ratings     |                          | Limiting speeds <sup>2)</sup> |                                  | Preload force <sup>3)</sup> |       |        | Lift-off force <sup>3)</sup> |        |        | Axial rigidity <sup>3)</sup> |       |        |
|----------------|-----------------|-----------------|------------------------|--------------------------|-------------------------------|----------------------------------|-----------------------------|-------|--------|------------------------------|--------|--------|------------------------------|-------|--------|
| r <sub>a</sub> | r <sub>a1</sub> | E <sub>tk</sub> | dyn.<br>C <sub>r</sub> | stat.<br>C <sub>0r</sub> | n <sub>G</sub> grease         | n <sub>G</sub> oil <sup>4)</sup> | L                           | M     | H      | L                            | M      | H      | L                            | M     | H      |
| max.           |                 | nom.            | kN                     | kN                       | min <sup>-1</sup>             | min <sup>-1</sup>                | N                           | N     | N      | N                            | N      | N      | N/μm                         | N/μm  | N/μm   |
| 1              | 1               | 184,3           | 128                    | 106                      | 6 000                         | 9 000                            | 722                         | 2 304 | 4 619  | 2 209                        | 7 572  | 16 164 | 145,4                        | 242,9 | 343,5  |
| 1              | 1               | 184,3           | 121                    | 100                      | 5 300                         | 8 000                            | 1 055                       | 3 579 | 7 439  | 3 062                        | 10 696 | 22 899 | 341,4                        | 539,4 | 724,8  |
| 1              | 1               | 184,3           | 128                    | 101                      | 8 000                         | 12 000                           | 374                         | 1 265 | 2 614  | 1 108                        | 3 944  | 8 551  | 125,5                        | 205,5 | 285    |
| 1              | 1               | 184,3           | 121                    | 96                       | 7 500                         | 11 000                           | 521                         | 1 940 | 4 152  | 1 495                        | 5 676  | 12 392 | 300,5                        | 481,2 | 641,9  |
| 2              | 1               | 191             | 192                    | 146                      | 5 600                         | 8 500                            | 1 145                       | 3 574 | 7 107  | 3 520                        | 11 821 | 25 044 | 163,1                        | 271,4 | 383,56 |
| 2              | 1               | 191             | 182                    | 138                      | 5 000                         | 7 500                            | 1 715                       | 5 606 | 11 519 | 4 988                        | 16 807 | 35 587 | 384,6                        | 601,1 | 805,7  |
| 2,5            | 2,5             | 215,5           | 249                    | 202                      | 4 300                         | 6 300                            | 1 502                       | 4 659 | 9 263  | 4 601                        | 15 309 | 32 375 | 178,8                        | 295,3 | 415,7  |
| 2,5            | 2,5             | 215,5           | 236                    | 192                      | 3 800                         | 5 600                            | 2 326                       | 7 493 | 15 324 | 6 760                        | 22 418 | 47 204 | 428,5                        | 665   | 888,2  |
| 2              | 1               | 191             | 192                    | 140                      | 7 500                         | 12 000                           | 609                         | 1 986 | 4 053  | 1 812                        | 6 221  | 13 337 | 141,9                        | 230   | 318,3  |
| 2              | 1               | 191             | 182                    | 132                      | 7 000                         | 11 000                           | 898                         | 3 121 | 6 545  | 2 581                        | 9 154  | 19 595 | 345                          | 540,5 | 716,9  |
| 2,5            | 2,5             | 215,5           | 249                    | 193                      | 5 300                         | 8 000                            | 827                         | 2 657 | 5 402  | 2 457                        | 8 298  | 17 692 | 158                          | 254   | 350,1  |
| 2,5            | 2,5             | 215,5           | 236                    | 184                      | 4 500                         | 6 700                            | 1 235                       | 4 183 | 8 703  | 3 550                        | 12 254 | 26 003 | 386,5                        | 599,3 | 769,6  |
| 1              | 1               | 194,3           | 133                    | 115                      | 5 600                         | 8 500                            | 742                         | 2 375 | 4 770  | 2 266                        | 7 779  | 16 624 | 153,6                        | 256,2 | 362    |
| 1              | 1               | 194,3           | 126                    | 108                      | 5 000                         | 7 500                            | 1 105                       | 3 757 | 7 816  | 3 206                        | 11 221 | 24 031 | 364,1                        | 575,2 | 772,6  |
| 1              | 1               | 194,3           | 133                    | 110                      | 7 500                         | 12 000                           | 385                         | 1 306 | 2 703  | 1 138                        | 4 063  | 8 815  | 132,8                        | 217,4 | 301,2  |
| 1              | 1               | 194,3           | 126                    | 104                      | 7 000                         | 11 000                           | 534                         | 2 004 | 4 295  | 1 533                        | 5 856  | 12 804 | 318,2                        | 510,3 | 680,6  |
| 2              | 1               | 203,8           | 241                    | 189                      | 5 300                         | 8 000                            | 1 448                       | 4 488 | 8 919  | 4 439                        | 14 768 | 31 222 | 170,7                        | 282   | 397,19 |
| 2              | 1               | 203,8           | 229                    | 180                      | 4 500                         | 7 000                            | 2 250                       | 7 240 | 14 802 | 6 541                        | 21 677 | 45 639 | 409                          | 634,9 | 848,3  |
| 3              | 3               | 228,6           | 300                    | 255                      | 3 800                         | 5 600                            | 1 864                       | 5 749 | 11 422 | 5 698                        | 18 828 | 39 747 | 189                          | 310,7 | 436,3  |
| 3              | 3               | 228,6           | 285                    | 241                      | 3 600                         | 5 300                            | 2 860                       | 9 126 | 18 610 | 8 307                        | 27 255 | 57 164 | 452,4                        | 698,5 | 930,4  |
| 1              | 1               | 208,3           | 171                    | 146                      | 5 300                         | 8 000                            | 960                         | 3 036 | 6 076  | 2 933                        | 9 953  | 21 191 | 167,9                        | 279,1 | 393,7  |
| 1              | 1               | 208,3           | 162                    | 138                      | 4 500                         | 7 000                            | 1 468                       | 4 890 | 10 108 | 4 263                        | 14 618 | 31 112 | 401,6                        | 630,3 | 845    |
| 1              | 1               | 208,3           | 171                    | 139                      | 7 000                         | 11 000                           | 519                         | 1 726 | 3 546  | 1 540                        | 5 380  | 11 597 | 147,6                        | 240   | 332    |
| 1              | 1               | 208,3           | 162                    | 132                      | 6 300                         | 10 000                           | 731                         | 2 635 | 5 587  | 2 098                        | 7 710  | 16 669 | 354,4                        | 561   | 745,5  |
| 2              | 1               | 218,8           | 248                    | 203                      | 4 800                         | 7 500                            | 1 502                       | 4 659 | 9 263  | 4 601                        | 15 309 | 32 375 | 178,8                        | 295,3 | 415,74 |
| 2              | 1               | 218,8           | 236                    | 193                      | 4 300                         | 6 700                            | 2 326                       | 7 493 | 15 324 | 6 760                        | 22 418 | 47 204 | 428,5                        | 665   | 888,2  |
| 3              | 3               | 238,6           | 310                    | 270                      | 3 800                         | 5 600                            | 1 891                       | 5 843 | 11 625 | 5 771                        | 19 076 | 40 296 | 196,7                        | 322,6 | 452,6  |
| 3              | 3               | 238,6           | 295                    | 260                      | 3 400                         | 5 000                            | 2 957                       | 9 444 | 19 266 | 8 585                        | 28 184 | 59 117 | 474,9                        | 733   | 976    |

# Spindle bearings

With large balls  
Steel or ceramic balls  
Steel rings  
Open



**Dimension table** (continued) · Dimensions in mm

| Designation <sup>1)</sup> |                      |                      | Mass<br>m<br>≈ kg | Dimensions |     |    |      |                | Contact<br>angle<br>α<br>° | Mounting<br>dimensions |                       |
|---------------------------|----------------------|----------------------|-------------------|------------|-----|----|------|----------------|----------------------------|------------------------|-----------------------|
| Series 719                | Series 70            | Series 72            |                   | d          | D   | B  | r    | r <sub>1</sub> |                            | d <sub>a</sub><br>h12  | D <sub>a</sub><br>H12 |
|                           |                      |                      |                   |            |     |    | min. |                |                            |                        |                       |
| <b>B71938-C-T-P4S</b>     | –                    | –                    | 4,33              | <b>190</b> | 260 | 33 | 2    | 1              | 15                         | 202                    | 247                   |
| <b>B71938-E-T-P4S</b>     | –                    | –                    | 4,31              | <b>190</b> | 260 | 33 | 2    | 1              | 25                         | 202                    | 247                   |
| <b>HCB71938-C-T-P4S</b>   | –                    | –                    | 3,6               | <b>190</b> | 260 | 33 | 2    | 1              | 15                         | 202                    | 247                   |
| <b>HCB71938-E-T-P4S</b>   | –                    | –                    | 3,58              | <b>190</b> | 260 | 33 | 2    | 1              | 25                         | 202                    | 247                   |
| –                         | <b>B7038-C-T-P4S</b> | –                    | 9,2               | <b>190</b> | 290 | 46 | 2,1  | 2,1            | 15                         | 206                    | 274                   |
| –                         | <b>B7038-E-T-P4S</b> | –                    | 9,16              | <b>190</b> | 290 | 46 | 2,1  | 2,1            | 25                         | 206                    | 274                   |
| –                         | –                    | <b>B7238-C-T-P4S</b> | 20                | <b>190</b> | 340 | 55 | 4    | 4              | 15                         | 223,5                  | 306,5                 |
| –                         | –                    | <b>B7238-E-T-P4S</b> | 20                | <b>190</b> | 340 | 55 | 4    | 4              | 25                         | 223,5                  | 306,5                 |
| <b>B71940-C-T-P4S</b>     | –                    | –                    | 6,05              | <b>200</b> | 280 | 38 | 2,1  | 1,1            | 15                         | 214                    | 266                   |
| <b>B71940-E-T-P4S</b>     | –                    | –                    | 6,03              | <b>200</b> | 280 | 38 | 2,1  | 1,1            | 25                         | 214                    | 266                   |
| <b>HCB71940-C-T-P4S</b>   | –                    | –                    | 5,07              | <b>200</b> | 280 | 38 | 2,1  | 1,1            | 15                         | 214                    | 266                   |
| <b>HCB71940-E-T-P4S</b>   | –                    | –                    | 5,04              | <b>200</b> | 280 | 38 | 2,1  | 1,1            | 25                         | 214                    | 266                   |
| –                         | <b>B7040-C-T-P4S</b> | –                    | 11,6              | <b>200</b> | 310 | 51 | 2,1  | 2,1            | 15                         | 217                    | 293                   |
| –                         | <b>B7040-E-T-P4S</b> | –                    | 11,6              | <b>200</b> | 310 | 51 | 2,1  | 2,1            | 25                         | 217                    | 293                   |
| –                         | –                    | <b>B7240-C-T-P4S</b> | 24,2              | <b>200</b> | 360 | 58 | 4    | 4              | 15                         | 238,5                  | 321,5                 |
| –                         | –                    | <b>B7240-E-T-P4S</b> | 24,2              | <b>200</b> | 360 | 58 | 4    | 4              | 25                         | 238,5                  | 321,5                 |
| <b>B71944-C-T-P4S</b>     | –                    | –                    | 6,6               | <b>220</b> | 300 | 38 | 2,1  | 1,1            | 15                         | 234                    | 286                   |
| <b>B71944-E-T-P4S</b>     | –                    | –                    | 6,58              | <b>220</b> | 300 | 38 | 2,1  | 1,1            | 25                         | 234                    | 286                   |
| <b>HCB71944-C-T-P4S</b>   | –                    | –                    | 5,49              | <b>220</b> | 300 | 38 | 2,1  | 1,1            | 15                         | 234                    | 286                   |
| <b>HCB71944-E-T-P4S</b>   | –                    | –                    | 5,47              | <b>220</b> | 300 | 38 | 2,1  | 1,1            | 25                         | 234                    | 286                   |
| –                         | <b>B7044-C-T-P4S</b> | –                    | 15,7              | <b>220</b> | 340 | 56 | 3    | 3              | 15                         | 239                    | 321                   |
| –                         | <b>B7044-E-T-P4S</b> | –                    | 15,7              | <b>220</b> | 340 | 56 | 3    | 3              | 25                         | 239                    | 321                   |
| –                         | –                    | <b>B7244-C-T-P4S</b> | 33,1              | <b>220</b> | 400 | 65 | 4    | 4              | 15                         | 264                    | 356                   |
| –                         | –                    | <b>B7244-E-T-P4S</b> | 33,1              | <b>220</b> | 400 | 65 | 4    | 4              | 25                         | 264                    | 356                   |

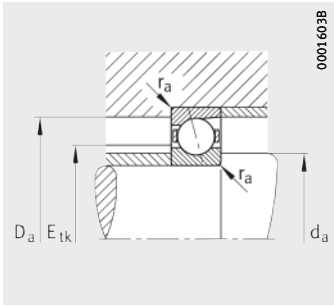
<sup>1)</sup> Explanation of short designations, see page 130.

<sup>2)</sup> The limiting speeds in the dimension tables are based on elastically preloaded single bearings.

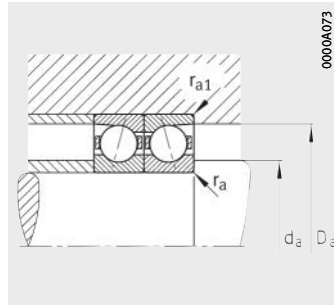
<sup>3)</sup> Explanation, see page 62.

<sup>4)</sup> Minimal quantity oil lubrication.





Mounting dimensions



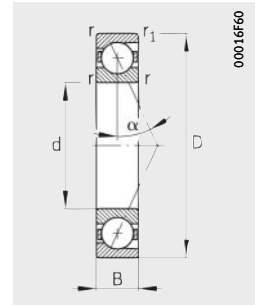
Mounting dimensions



|                |                 |                 | Basic load ratings     |                          | Limiting speeds <sup>2)</sup> |                                  | Preload force <sup>3)</sup> |        |        | Lift-off force <sup>3)</sup> |        |        | Axial rigidity <sup>3)</sup> |       |         |
|----------------|-----------------|-----------------|------------------------|--------------------------|-------------------------------|----------------------------------|-----------------------------|--------|--------|------------------------------|--------|--------|------------------------------|-------|---------|
| r <sub>a</sub> | r <sub>a1</sub> | E <sub>tk</sub> | dyn.<br>C <sub>r</sub> | stat.<br>C <sub>0r</sub> | n <sub>G</sub> grease         | n <sub>G</sub> oil <sup>4)</sup> | L                           | M      | H      | L                            | M      | H      | L                            | M     | H       |
| max.           |                 | nom.            | kN                     | kN                       | min <sup>-1</sup>             | min <sup>-1</sup>                | N                           | N      | N      | N                            | N      | N      | N/μm                         | N/μm  | N/μm    |
| 1              | 1               | 218,3           | 174                    | 152                      | 5 000                         | 7 500                            | 888                         | 2 947  | 5 992  | 2 700                        | 9 612  | 20 790 | 166,3                        | 280,7 | 398,1   |
| 1              | 1               | 218,3           | 164                    | 144                      | 4 500                         | 6 700                            | 1 250                       | 4 547  | 9 653  | 3 619                        | 13 545 | 29 595 | 388,3                        | 627   | 847,4   |
| 1              | 1               | 218,3           | 174                    | 146                      | 6 700                         | 10 000                           | 450                         | 1 629  | 3 436  | 1 328                        | 5 053  | 11 178 | 143                          | 239,3 | 333,8   |
| 1              | 1               | 218,3           | 164                    | 138                      | 6 000                         | 9 500                            | 557                         | 2 383  | 5 290  | 1 596                        | 6 951  | 15 738 | 330,5                        | 553,6 | 747     |
| 2              | 1               | 228,8           | 255                    | 215                      | 4 500                         | 7 000                            | 1 436                       | 4 599  | 9 248  | 4 377                        | 15 038 | 32 154 | 180,9                        | 301,6 | 425,78  |
| 2              | 1               | 228,8           | 243                    | 204                      | 4 000                         | 6 300                            | 2 128                       | 7 254  | 15 104 | 6 172                        | 21 646 | 46 379 | 428,8                        | 677,5 | 909,7   |
| 3              | 3               | 253,6           | 320                    | 290                      | 3 400                         | 5 000                            | 1 846                       | 5 864  | 11 779 | 5 614                        | 19 073 | 40 669 | 201,1                        | 332,6 | 467,9   |
| 3              | 3               | 253,6           | 305                    | 275                      | 3 200                         | 4 800                            | 2 797                       | 9 366  | 19 397 | 8 105                        | 27 894 | 59 391 | 481,8                        | 755,2 | 1 010,2 |
| 1              | 1               | 232,4           | 210                    | 179                      | 4 500                         | 7 000                            | 1 127                       | 3 678  | 7 439  | 3 433                        | 12 027 | 25 875 | 179,5                        | 301,5 | 427     |
| 1              | 1               | 232,4           | 199                    | 170                      | 4 000                         | 6 300                            | 1 635                       | 5 765  | 12 127 | 4 737                        | 17 199 | 37 246 | 422,5                        | 675,8 | 911     |
| 1              | 1               | 232,4           | 210                    | 171                      | 6 300                         | 10 000                           | 571                         | 2 012  | 4 211  | 1 688                        | 6 249  | 13 711 | 154,2                        | 255,5 | 355,4   |
| 1              | 1               | 232,4           | 199                    | 162                      | 5 600                         | 9 000                            | 768                         | 3 083  | 6 732  | 2 202                        | 9 005  | 20 060 | 366                          | 600,6 | 806,2   |
| 2              | 1               | 241,5           | 310                    | 270                      | 4 300                         | 6 700                            | 1 791                       | 5 681  | 11 402 | 5 451                        | 18 508 | 39 448 | 192,3                        | 318,4 | 448,15  |
| 2              | 1               | 241,5           | 295                    | 260                      | 3 800                         | 6 000                            | 2 711                       | 9 065  | 18 765 | 7 860                        | 27 018 | 57 509 | 460,2                        | 721,5 | 965,4   |
| 3              | 3               | 268,6           | 330                    | 310                      | 3 200                         | 4 800                            | 1 902                       | 6 047  | 12 156 | 5 777                        | 19 638 | 41 892 | 209,8                        | 346,8 | 487,5   |
| 3              | 3               | 268,6           | 315                    | 295                      | 3 000                         | 4 500                            | 2 882                       | 9 666  | 20 030 | 8 349                        | 28 771 | 61 275 | 503,3                        | 788,9 | 1 055   |
| 1              | 1               | 252,4           | 224                    | 203                      | 4 300                         | 6 700                            | 1 185                       | 3 886  | 7 879  | 3 600                        | 12 649 | 27 258 | 195,9                        | 328,6 | 464,6   |
| 1              | 1               | 252,4           | 212                    | 192                      | 3 800                         | 6 000                            | 1 705                       | 6 060  | 12 777 | 4 937                        | 18 042 | 39 132 | 461,4                        | 738,5 | 994,8   |
| 1              | 1               | 252,4           | 224                    | 194                      | 6 000                         | 9 000                            | 606                         | 2 147  | 4 503  | 1 788                        | 6 651  | 14 612 | 169,1                        | 280,3 | 389,5   |
| 1              | 1               | 252,4           | 212                    | 184                      | 5 300                         | 8 000                            | 779                         | 3 184  | 6 985  | 2 232                        | 9 284  | 20 766 | 396,1                        | 652,9 | 876,7   |
| 2,5            | 1               | 266,5           | 330                    | 310                      | 4 000                         | 6 000                            | 1 902                       | 6 047  | 12 156 | 5 777                        | 19 638 | 41 892 | 209,8                        | 346,8 | 487,53  |
| 2,5            | 1               | 266,5           | 315                    | 295                      | 3 600                         | 5 300                            | 2 882                       | 9 666  | 20 030 | 8 349                        | 28 771 | 61 275 | 503,3                        | 788,9 | 1 055   |
| 3              | 3               | 296,2           | 405                    | 400                      | 2 800                         | 4 300                            | 2 387                       | 7 527  | 15 105 | 7 238                        | 24 345 | 51 776 | 224                          | 367,7 | 515,3   |
| 3              | 3               | 296,2           | 385                    | 380                      | 2 600                         | 4 000                            | 3 642                       | 12 021 | 24 787 | 10 546                       | 35 720 | 75 626 | 539,7                        | 839,9 | 1 119,3 |

# Spindle bearings

With large balls  
 Steel or ceramic balls  
 Steel rings  
 Open



**Dimension table** (continued) · Dimensions in mm

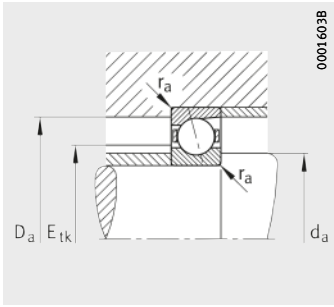
| Designation <sup>1)</sup> |                      | Mass<br>m<br>≈ kg | Dimensions |     |    |     |                | Contact angle<br>α<br>° | Mounting dimensions   |                       |                        |                         |                         |
|---------------------------|----------------------|-------------------|------------|-----|----|-----|----------------|-------------------------|-----------------------|-----------------------|------------------------|-------------------------|-------------------------|
| Series 719                | Series 70            |                   | d          | D   | B  | r   | r <sub>1</sub> |                         | d <sub>a</sub><br>h12 | D <sub>a</sub><br>H12 | r <sub>a</sub><br>max. | r <sub>a1</sub><br>max. | E <sub>tk</sub><br>nom. |
| <b>B71948-C-T-P4S</b>     | –                    | 7,1               | <b>240</b> | 320 | 38 | 2,1 | 1,1            | 15                      | 254                   | 307                   | 1                      | 1                       | 272,4                   |
| <b>B71948-E-T-P4S</b>     | –                    | 7,08              | <b>240</b> | 320 | 38 | 2,1 | 1,1            | 25                      | 254                   | 307                   | 1                      | 1                       | 272,4                   |
| –                         | <b>B7048-C-T-P4S</b> | 16,8              | <b>240</b> | 360 | 56 | 3   | 3              | 15                      | 260                   | 341                   | 2,5                    | 1                       | 286,5                   |
| –                         | <b>B7048-E-T-P4S</b> | 16,7              | <b>240</b> | 360 | 56 | 3   | 3              | 25                      | 260                   | 341                   | 2,5                    | 1                       | 286,5                   |
| <b>B71952-C-T-P4S</b>     | –                    | 12                | <b>260</b> | 360 | 46 | 2,1 | 1,1            | 15                      | 278                   | 342                   | 1                      | 1                       | 300,5                   |
| <b>B71956-C-T-P4S</b>     | –                    | 12,9              | <b>280</b> | 380 | 46 | 2,1 | 1,1            | 15                      | 298                   | 362                   | 1                      | 1                       | 320,5                   |
| <b>B71960-C-T-P4S</b>     | –                    | 20                | <b>300</b> | 420 | 56 | 3   | 1,1            | 15                      | 322                   | 398                   | 1                      | 1                       | 348,6                   |

<sup>1)</sup> Explanation of short designations, see page 130.

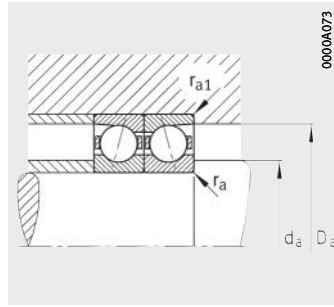
<sup>2)</sup> The limiting speeds in the dimension tables are based on elastically preloaded single bearings.

<sup>3)</sup> Explanation, see page 62.

<sup>4)</sup> Minimal quantity oil lubrication.



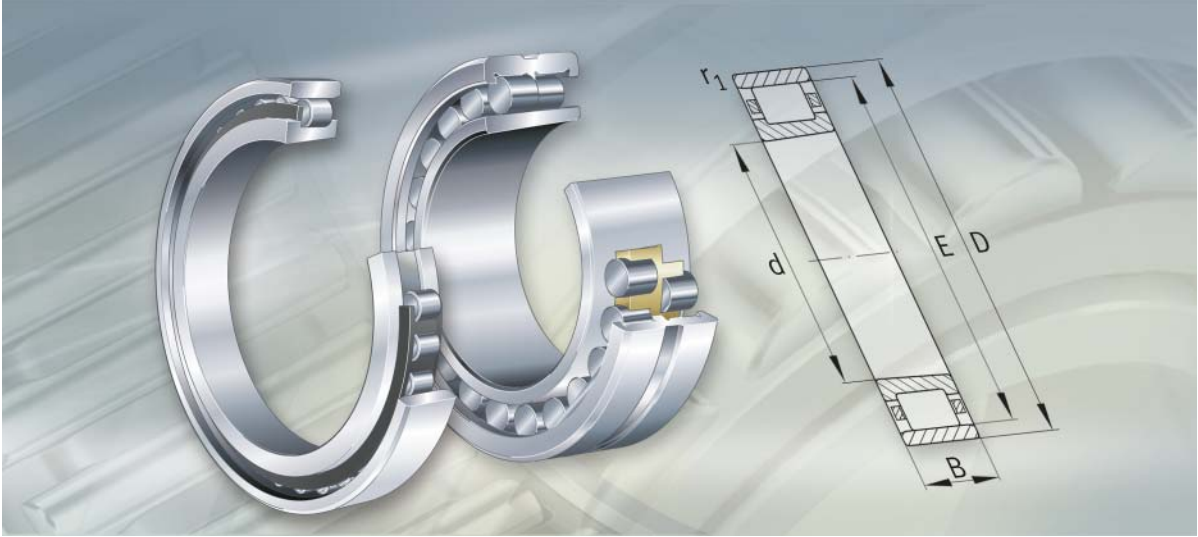
Mounting dimensions



Mounting dimensions



| Basic load ratings  |                         | Limiting speeds <sup>2)</sup>     |  | Preload force <sup>3)</sup><br>$F_v$ |        |        | Lift-off force <sup>3)</sup><br>$K_{aE}$ |        |        | Axial rigidity <sup>3)</sup><br>$c_a$ |                             |                             |
|---------------------|-------------------------|-----------------------------------|--|--------------------------------------|--------|--------|--|--------|--------|---------------------------------------|-----------------------------|-----------------------------|
| dyn.<br>$C_r$<br>kN | stat.<br>$C_{0r}$<br>kN | $n_G$ grease<br>$\text{min}^{-1}$ | $n_G$ oil <sup>4)</sup><br>$\text{min}^{-1}$ | L<br>N                               | M<br>N | H<br>N | L<br>N                                   | M<br>N | H<br>N | L<br>$\text{N}/\mu\text{m}$           | M<br>$\text{N}/\mu\text{m}$ | H<br>$\text{N}/\mu\text{m}$ |
| 231                 | 220                     | 4 000                             | 6 000  | 1 224                                | 4 024  | 8 171  | 3 712                                    | 13 066 | 28 181 | 206,8                                 | 346,5                       | 489,6                       |
| 218                 | 208                     | 3 600                             | 5 300  | 1 760                                | 6 279  | 13 255 | 5 092                                    | 18 673 | 40 536 | 487,7                                 | 781,1                       | 1 051,8                     |
| 340                 | 330                     | 3 600                             | 5 600  | 1 957                                | 6 231  | 12 533 | 5 940                                    | 20 205 | 43 114 | 218,5                                 | 360,9                       | 507,16                      |
| 320                 | 310                     | 3 200                             | 5 000  | 2 914                                | 9 801  | 20 327 | 8 437                                    | 29 140 | 62 090 | 521,3                                 | 817,3                       | 1 092,3                     |
| 295                 | 290                     | 3 600                             | 5 300  | 1 615                                | 5 221  | 10 556 | 4 894                                    | 16 900 | 36 243 | 221,7                                 | 368                         | 517,8                       |
| 305                 | 320                     | 3 200                             | 5 000  | 1 696                                | 5 491  | 11 113 | 5 134                                    | 17 744 | 38 073 | 236,4                                 | 392                         | 551,3                       |
| 370                 | 405                     | 3 000                             | 4 500  | 2 084                                | 6 676  | 13 480 | 6 297                                    | 21 485 | 45 930 | 248,6                                 | 409,3                       | 573,5                       |



# Super precision cylindrical roller bearings

Single row

Double row

# Super precision cylindrical roller bearings

|  | Page |
|--|------|
| <b>Product overview</b>  |      |
| Super precision cylindrical roller bearings.....   | 192  |
| <b>Features</b>  |      |
| Ideal non-locating bearings .....  | 193  |
| X-life cylindrical roller bearings .....   | 193  |
| Bearings with smaller cross-section .....  | 194  |
| Single row cylindrical roller bearings.....  | 195  |
| Double row cylindrical roller bearings .....   | 196  |
| Sealing.....   | 196  |
| Lubrication .....  | 196  |
| Cages.....   | 197  |
| Bearing designations.....  | 198  |
| Marking of bearings.....   | 199  |
| <b>Dimension tables</b>  |      |
| Super precision cylindrical roller bearings,<br>single row, steel or ceramic rollers ..... | 200  |
| Super precision cylindrical roller bearings,<br>single row, steel rollers.....             | 210  |
| Super precision cylindrical roller bearings,<br>double row .....                           | 214  |



# Product overview Super precision cylindrical roller bearings

**Single row,  
tapered bore**

X-life  
Standard

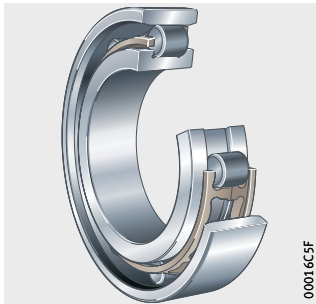
N10..-K-TVP-XL,  
N10..-K-M1, N19..-K-M1



00096733

**Hybrid bearings  
with half the number of rollers**

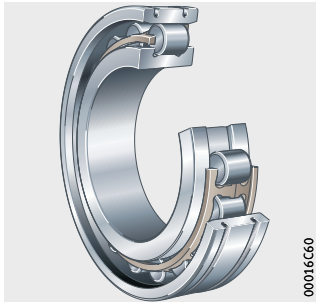
HCN10..-K-PVPA1-..-H193



00016C5F

**Thermally robust design**

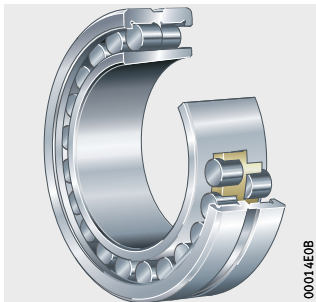
N10..-K-TR-PVPA1,  
HCN10..-K-TR



00016C60

**Double row,  
tapered bore**

NN30..-K-TVP-XL, NN30..-K,  
NNU49..-K-M



00014ECB

# Super precision cylindrical roller bearings

**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 removable and can thus be mounted separately from the rest of the bearing package. The inner ring is only removable 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. The bearings 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.

## Ideal non-locating bearings

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.

The standard series N10, N19, HCN10 (single row) and NN30, NNU49 (double row) are an established part of the FAG super precision range. Diameter ranges not shown in the catalogue are available by agreement.



## X-life cylindrical roller bearings

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 bearing rating life. A newly developed plastic cage gives lower friction.

The advantages of this bearing 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 bearing rating life  $L_{10}$  is up to 65% longer than the previous standard.

As a result of the increase in the basic bearing 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.

# Super precision cylindrical roller bearings

## Single row cylindrical roller bearings

Single row super precision cylindrical roller bearings are available:

- with a tapered or cylindrical bore on the inner ring
- as hybrid cylindrical roller bearings with half the number of rollers
- in a thermally robust design
- as a Direct Lube design.

In the series N10 and N19, the rollers are guided on the inner ring and held at a spacing from each other by a cage made from brass or PEEK, *Figure 1*.



*Figure 1*  
Single row cylindrical roller bearing

## Bearings with smaller cross-section

The super precision cylindrical roller bearings N19 and NNU49 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 dimension tables can be supplied by agreement.



## Hybrid cylindrical roller bearings with half the number of rollers

In hybrid cylindrical roller bearings, the rollers are made from a high performance ceramic. This material gives a significant reduction in the friction and wear in the bearing. In addition, there is less strain on the lubricant and temperatures in the bearing are lower. As a result, cylindrical roller bearings of the hybrid design 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 with half the number of rollers have the suffix H193, *Figure 2*. Due to the reduction in the number of rollers, the speed can be increased further.

HCN10..-K-H193

*Figure 2*  
Hybrid bearing  
with half the number of rollers

### Thermally robust design

With these bearings (suffix TR), temperature fluctuations on the non-locating bearing side of motor spindles can be compensated very effectively even at the very highest speeds.

This is due to the radial elasticity of the outer ring. This has two undercuts and a slight recess across the central area. As a result the contact forces are lower under variable temperature differences.

Due to these advantages, the bearing is the ideal non-locating bearing for motor spindle applications.



# Super precision cylindrical roller bearings

## Double row cylindrical roller bearings

In bearings of series NN30, the rollers are guided on the inner ring. The outer ring is ground cylindrically and is removable, *Figure 3*.

Series NNU49 has a cylindrically ground, separable inner ring. The rollers are guided on the outer ring.

NN30

*Figure 3*  
Double row cylindrical roller bearing



### Sealing

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

### Lubrication

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

### Pneumatic oil 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 dimension 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 rib on the inner ring and the inside diameter of the cage. Lubrication is possible from both sides.

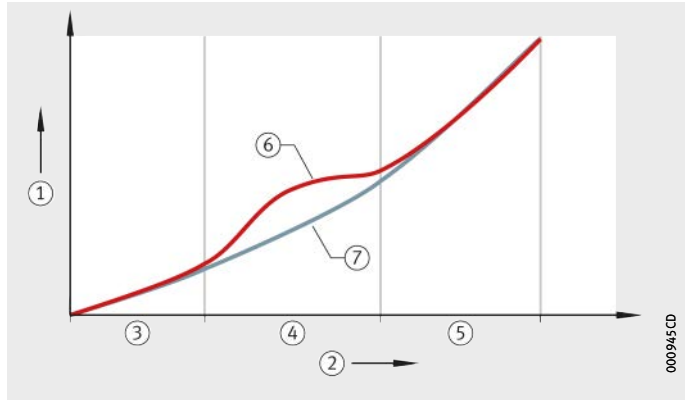
In cylindrical roller bearings with a PEEK cage guided on one side (PVPA1), lubrication can also be carried out on both sides between the rib on the inner ring and the inside diameter of the cage ( $E_{tk1}$ ). As an alternative, lubrication can be carried out on the open side of the cage between the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

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 is then reliably conveyed out of the bearing, giving a highly uniform temperature behaviour of the bearing.

- ① Temperature
- ② Speed
- ③ Low
- ④ Moderate
- ⑤ High
- ⑥ Lubrication between inner ring and cage  $E_{tk2}$
- ⑦ Lubrication on open side of cage  $E_{tk2}$

*Figure 4*  
Speed/temperature behaviour of cylindrical roller bearings with cage guided on outer ring with oil lubrication



#### Oil lubrication

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



Bearings with a modified internal construction and the 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.

#### Cages

Single row super precision cylindrical roller bearings have solid cages made from polyamide (TVP) and brass (M1) or PEEK (PVPA1). Double row bearings have solid cages made from polyamide (TVP) or brass (M1).



# Super precision cylindrical roller bearings

## Bearing designations

The designation structure for single row cylindrical roller bearings is shown in *Figure 5*, the structure for double row bearings is shown in *Figure 6*.

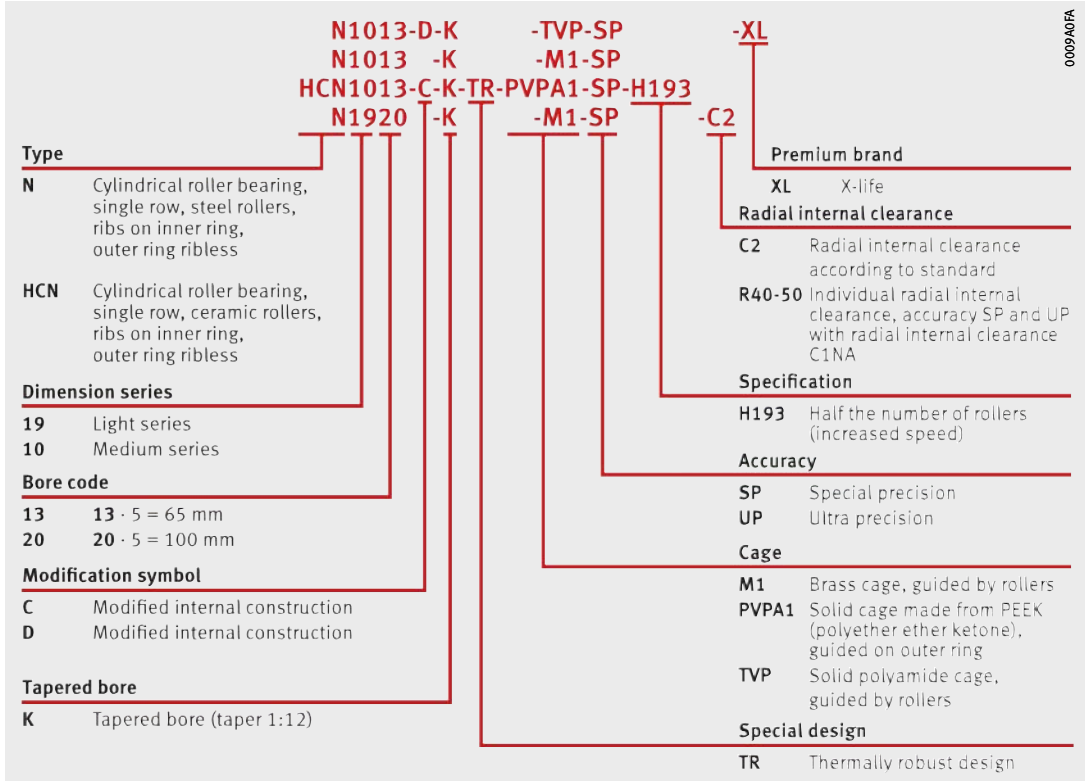


Figure 5  
Bearing designation

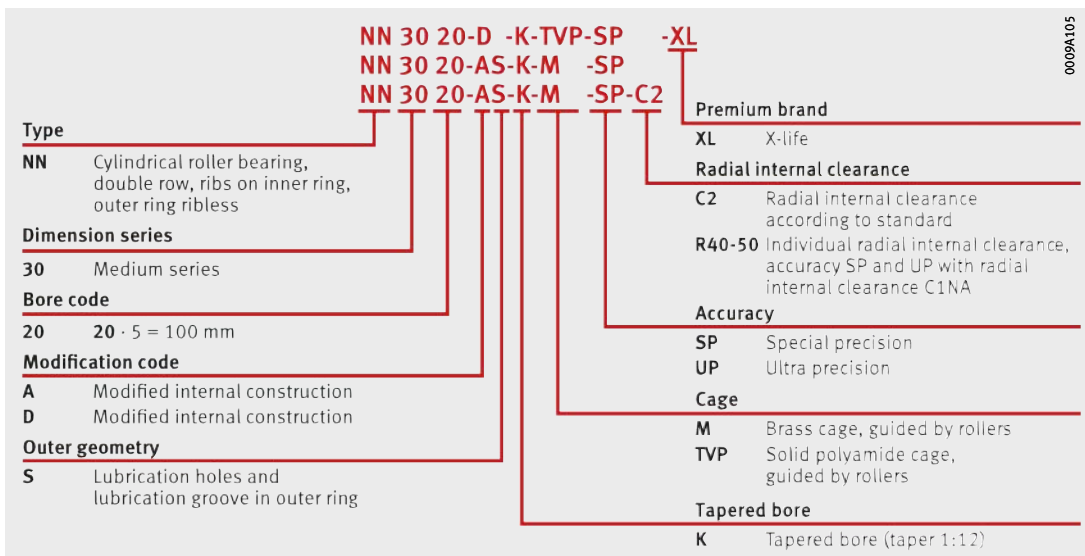


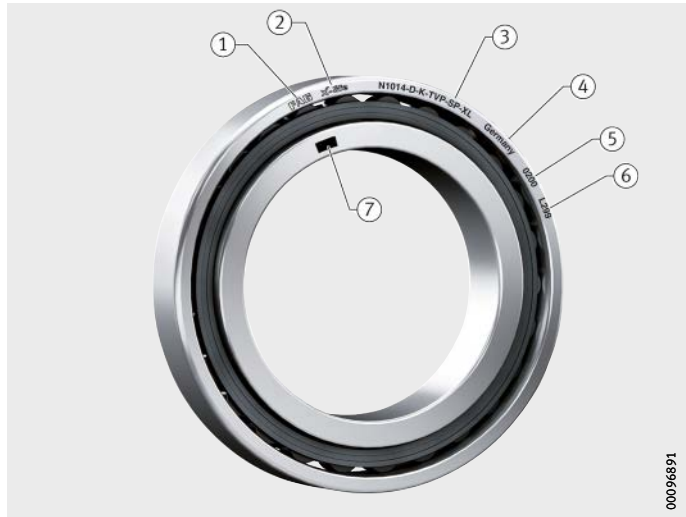
Figure 6  
Bearing designation

## Marking of bearings

Marking of the bearings on the end faces of the bearing rings is shown in *Figure 7* and *Figure 8*.

- ① Trademark
- ② X-life symbol
- ③ Short designation (bearing designation)
- ④ Country of manufacture
- ⑤ Internal code
- ⑥ Internal code
- ⑦ Data matrix code

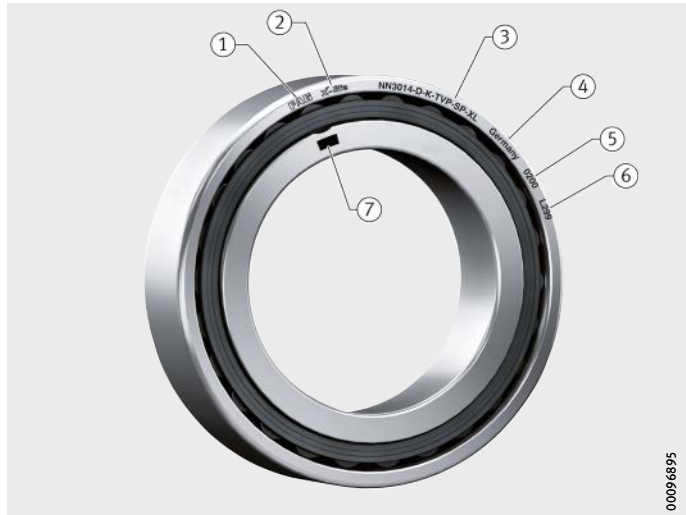
*Figure 7*  
Marking  
of single row bearings



00096891

- ① Trademark
- ② X-life symbol
- ③ Short designation (bearing designation)
- ④ Country of manufacture
- ⑤ Internal code
- ⑥ Internal code
- ⑦ Data matrix code

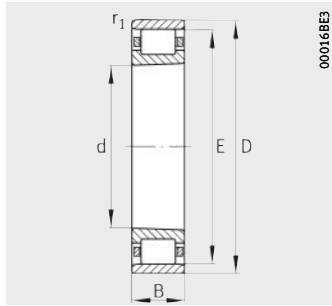
*Figure 8*  
Marking  
of double row bearings



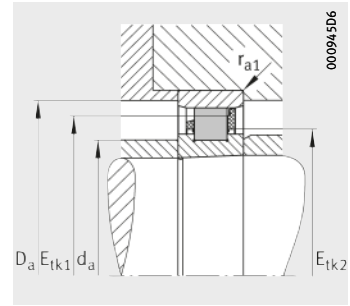
00096895

# Super precision cylindrical roller bearings

Single row  
Steel or ceramic rollers



N10, N19  
Steel rollers



HCN10  
Ceramic rollers

**Dimension table** - Dimensions in mm

| Designation <sup>1)</sup>                     | Mass<br>m<br>≈ kg | Dimensions |    |    |                        |      |                |                |                |
|---|-------------------|------------|----|----|------------------------|------|----------------|----------------|----------------|
|   |                   | d          | D  | B  | r <sub>1</sub><br>min. | E    | B <sub>N</sub> | S <sub>N</sub> | S <sub>B</sub> |
| Series 10 and 19                              |                   |            |    |    |                        |      |                |                |                |
| <b>N1006-D-K-TVP-SP-XL</b>                    | 0,12              | <b>30</b>  | 55 | 13 | 0,6                    | 48,5 | 2,8            | 7,2            | 1,4            |
| <b>N1006-K-M1-SP</b>                          | 0,15              | <b>30</b>  | 55 | 13 | 0,6                    | 48,5 | 2,8            | 7,2            | 1,4            |
| <b>N1006-K-PVPA1-SP<sup>4)</sup></b>          | 0,11              | <b>30</b>  | 55 | 13 | 0,6                    | 48,5 | 2,8            | 7,2            | 1,4            |
| <b>HCN1006-K-PVPA1-SP<sup>4)</sup></b>        | 0,11              | <b>30</b>  | 55 | 13 | 0,6                    | 48,5 | 2,8            | 7,2            | 1,4            |
| <b>HCN1006-K-PVPA1-SP-H193<sup>4)</sup></b>   | 0,1               | <b>30</b>  | 55 | 13 | 0,6                    | 48,5 | 2,8            | 7,2            | 1,4            |
| <b>N1007-D-K-TVP-SP-XL</b>                    | 0,16              | <b>35</b>  | 62 | 14 | 0,6                    | 55   | 2,8            | 8              | 1,4            |
| <b>N1007-K-M1-SP</b>                          | 0,17              | <b>35</b>  | 62 | 14 | 0,6                    | 55   | 2,8            | 8              | 1,4            |
| <b>N1007-C-K-PVPA1-SP<sup>4)</sup></b>        | 0,14              | <b>35</b>  | 62 | 14 | 0,6                    | 55   | 2,8            | 8              | 1,4            |
| <b>HCN1007-C-K-PVPA1-SP<sup>4)</sup></b>      | 0,14              | <b>35</b>  | 62 | 14 | 0,6                    | 55   | 2,8            | 8              | 1,4            |
| <b>HCN1007-C-K-PVPA1-SP-H193<sup>4)</sup></b> | 0,15              | <b>35</b>  | 62 | 14 | 0,6                    | 55   | 2,8            | 8              | 1,4            |
| <b>N1008-D-K-TVP-SP-XL</b>                    | 0,2               | <b>40</b>  | 68 | 15 | 0,6                    | 61   | 2,8            | 8,5            | 1,4            |
| <b>N1008-K-M1-SP</b>                          | 0,24              | <b>40</b>  | 68 | 15 | 0,6                    | 61   | 2,8            | 8,5            | 1,4            |
| <b>N1008-K-PVPA1-SP<sup>4)</sup></b>          | 0,16              | <b>40</b>  | 68 | 15 | 0,6                    | 61   | 2,8            | 8,5            | 1,4            |
| <b>HCN1008-K-PVPA1-SP<sup>4)</sup></b>        | 0,16              | <b>40</b>  | 68 | 15 | 0,6                    | 61   | 2,8            | 8,5            | 1,4            |
| <b>HCN1008-K-PVPA1-SP-H193<sup>4)</sup></b>   | 0,21              | <b>40</b>  | 68 | 15 | 0,6                    | 61   | 2,8            | 8,5            | 1,4            |
| <b>N1009-D-K-TVP-SP-XL</b>                    | 0,24              | <b>45</b>  | 75 | 16 | 0,6                    | 67,5 | 3,4            | 9,3            | 1,4            |
| <b>N1009-K-M1-SP</b>                          | 0,27              | <b>45</b>  | 75 | 16 | 0,6                    | 67,5 | 3,4            | 9,3            | 1,4            |
| <b>N1009-C-K-PVPA1-SP<sup>4)</sup></b>        | 0,22              | <b>45</b>  | 75 | 16 | 0,6                    | 67,5 | 3,4            | 9,3            | 1,4            |
| <b>HCN1009-C-K-PVPA1-SP<sup>4)</sup></b>      | 0,22              | <b>45</b>  | 75 | 16 | 0,6                    | 67,5 | 3,4            | 9,3            | 1,4            |
| <b>HCN1009-C-K-PVPA1-SP-H193<sup>4)</sup></b> | 0,2               | <b>45</b>  | 75 | 16 | 0,6                    | 67,5 | 3,4            | 9,3            | 1,4            |
| <b>N1910-K-M1-SP</b>                          | 0,15              | <b>50</b>  | 72 | 12 | 0,3                    | 66,5 | –              | –              | –              |
| <b>N1010-D-K-TVP-SP-XL</b>                    | 0,27              | <b>50</b>  | 80 | 16 | 0,6                    | 72,5 | 3,4            | 9,3            | 1,4            |
| <b>N1010-K-M1-SP</b>                          | 0,3               | <b>50</b>  | 80 | 16 | 0,6                    | 72,5 | 3,4            | 9,3            | 1,4            |
| <b>N1010-C-K-PVPA1-SP<sup>4)</sup></b>        | 0,23              | <b>50</b>  | 80 | 16 | 0,6                    | 72,5 | 3,4            | 9,3            | 1,4            |
| <b>HCN1010-C-K-PVPA1-SP<sup>4)</sup></b>      | 0,23              | <b>50</b>  | 80 | 16 | 0,6                    | 72,5 | 3,4            | 9,3            | 1,4            |
| <b>HCN1010-C-K-PVPA1-SP-H193<sup>4)</sup></b> | 0,22              | <b>50</b>  | 80 | 16 | 0,6                    | 72,5 | 3,4            | 9,3            | 1,4            |

<sup>1)</sup> Explanation of short designations, see page 198.

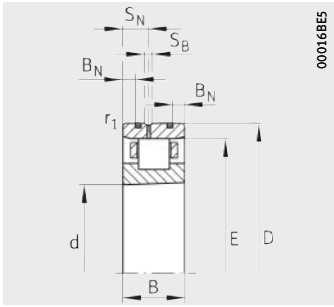
The bearings are also available by agreement in the following designs:

- With cylindrical bore (without suffix K),  
Ordering example: N1006-D-TVP-SP-XL
- As Direct Lube design (suffix DLR),  
Ordering example: N1006-K-DLR-PVPA1-SP.

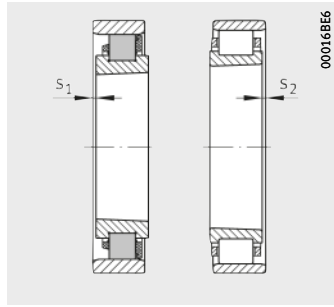
<sup>2)</sup> Axial displacement of outer ring from central position.

<sup>3)</sup> Minimal quantity oil lubrication.

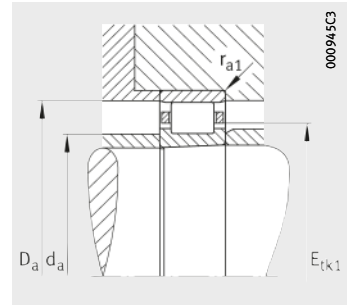
<sup>4)</sup> Also available as thermally robust design (suffix TR),  
Ordering example: N1006-K-TR-PVPA1-SP.



Direct Lube



Axial displacement



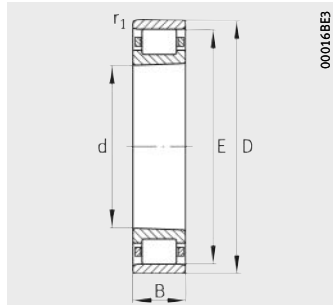
Mounting dimensions

| Axial displacement <sup>2)</sup> |                | Mounting dimensions   |                       |                          |                          |                         | Basic load ratings          |                               | Limiting speeds                            |   |
|----------------------------------|----------------|-----------------------|-----------------------|--------------------------|--------------------------|-------------------------|-----------------------------|-------------------------------|--|---|
| s <sub>1</sub>                   | s <sub>2</sub> | d <sub>a</sub><br>h12 | D <sub>a</sub><br>H12 | E <sub>tk1</sub><br>nom. | E <sub>tk2</sub><br>nom. | r <sub>a1</sub><br>max. | dyn.<br>C <sub>r</sub><br>N | stat.<br>C <sub>0r</sub><br>N | n <sub>G</sub> grease<br>min <sup>-1</sup> | n <sub>G</sub> oil <sup>3)</sup><br>min <sup>-1</sup> |
| 2,8                              | 2,8            | 38,5                  | 49,5                  | 47,5                     | –                        | 0,6                     | 17 500                      | 15 600                        | 22 000                                     | 26 000  |
| 1,9                              | 1,9            | 36,5                  | 49,4                  | 47                       | –                        | 0,6                     | 19 400                      | 19 300                        | 20 000                                     | 24 000  |
| 0,85                             | 2,2            | 36,5                  | 49,4                  | 47                       | 39,7                     | 0,6                     | 20 200                      | 20 400                        | 34 000                                     | 38 000  |
| 0,85                             | 2,2            | 36,5                  | 49,4                  | 47                       | 39,7                     | 0,6                     | 20 200                      | 19 200                        | 38 000                                     | 43 000  |
| 0,85                             | 2,2            | 36,5                  | 49,4                  | 47                       | 39,7                     | 0,6                     | 12 000                      | 9 600                         | 43 000                                     | 48 000  |
| 2,8                              | 2,8            | 43                    | 56                    | 53,9                     | –                        | 0,6                     | 23 600                      | 20 900                        | 19 000                                     | 22 000  |
| 2                                | 2              | 42                    | 56                    | 53,4                     | –                        | 0,6                     | 24 600                      | 26 000                        | 18 000                                     | 20 000  |
| 0,9                              | 2,4            | 43                    | 56,1                  | 53,4                     | 45,8                     | 0,6                     | 19 900                      | 20 900                        | 30 000                                     | 34 000  |
| 0,9                              | 2,4            | 43                    | 56,1                  | 53,4                     | 45,8                     | 0,6                     | 19 900                      | 19 600                        | 32 000                                     | 36 000  |
| 0,9                              | 2,4            | 43                    | 56,1                  | 53,4                     | 45,8                     | 0,6                     | 11 900                      | 9 800                         | 38 000                                     | 43 000  |
| 3,1                              | 3,1            | 49                    | 62,1                  | 59,8                     | –                        | 0,6                     | 27 000                      | 26 000                        | 17 000                                     | 20 000  |
| 2,1                              | 2,1            | 47                    | 62,1                  | 59,3                     | –                        | 0,6                     | 28 500                      | 30 500                        | 16 000                                     | 18 000  |
| 0,95                             | 2,5            | 47                    | 62,1                  | 59,3                     | 50,8                     | 0,6                     | 27 500                      | 29 000                        | 26 000                                     | 30 000  |
| 0,95                             | 2,5            | 47                    | 62,1                  | 59,3                     | 50,8                     | 0,6                     | 27 500                      | 27 000                        | 30 000                                     | 34 000  |
| 0,95                             | 2,5            | 47                    | 62,1                  | 59,3                     | 50,8                     | 0,6                     | 16 200                      | 13 600                        | 34 000                                     | 38 000  |
| 3,1                              | 3,1            | 53,5                  | 68,6                  | 66,2                     | –                        | 0,6                     | 34 500                      | 32 500                        | 16 000                                     | 18 000  |
| 2,2                              | 2,2            | 52,5                  | 68,6                  | 65,6                     | –                        | 0,6                     | 33 500                      | 37 500                        | 15 000                                     | 17 000  |
| 1,2                              | 2,5            | 53,5                  | 68,7                  | 65,6                     | 56,9                     | 0,6                     | 31 500                      | 34 500                        | 24 000                                     | 28 000  |
| 1,2                              | 2,5            | 53,5                  | 68,7                  | 65,6                     | 56,9                     | 0,6                     | 29 000                      | 31 000                        | 26 000                                     | 30 000  |
| 1,2                              | 2,5            | 53,5                  | 68,7                  | 65,6                     | 56,9                     | 0,6                     | 17 300                      | 15 400                        | 30 000                                     | 34 000  |
| 1,8                              | 1,8            | 55,5                  | 67                    | 65,1                     | –                        | 0,3                     | 22 300                      | 27 500                        | 15 000                                     | 17 000  |
| 3,1                              | 3,1            | 58,5                  | 73,6                  | 71,2                     | –                        | 0,6                     | 36 500                      | 36 500                        | 15 000                                     | 17 000  |
| 2,2                              | 2,2            | 57,5                  | 73,6                  | 70,6                     | –                        | 0,6                     | 36 000                      | 41 500                        | 14 000                                     | 16 000  |
| 1,15                             | 2,7            | 58,5                  | 73,7                  | 70,6                     | 61,9                     | 0,6                     | 31 000                      | 36 500                        | 22 000                                     | 26 000  |
| 1,15                             | 2,7            | 58,5                  | 73,7                  | 70,6                     | 61,9                     | 0,6                     | 31 000                      | 34 000                        | 24 000                                     | 28 000  |
| 1,15                             | 2,7            | 58,5                  | 73,7                  | 70,6                     | 61,9                     | 0,6                     | 18 400                      | 17 100                        | 28 000                                     | 32 000  |

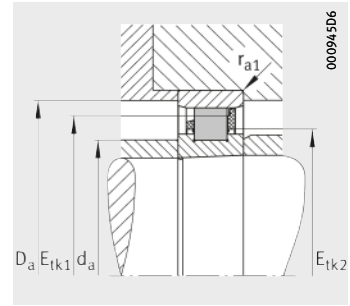


# Super precision cylindrical roller bearings

Single row  
Steel or ceramic rollers



N10, N19  
Steel rollers



HCN10  
Ceramic rollers

**Dimension table** (continued) · Dimensions in mm

| Designation <sup>1)</sup>                     | Mass<br>m<br>≈ kg | Dimensions |     |    |                        |      |                |                |                |
|---|-------------------|------------|-----|----|------------------------|------|----------------|----------------|----------------|
|   |                   | d          | D   | B  | r <sub>1</sub><br>min. | E    | B <sub>N</sub> | S <sub>N</sub> | S <sub>B</sub> |
| Series 10 and 19                              |                   |            |     |    |                        |      |                |                |                |
| <b>N1911-K-M1-SP</b>                          | 0,21              | <b>55</b>  | 80  | 13 | 0,6                    | 73,5 | –              | –              | –              |
| <b>N1011-D-K-TVP-SP-XL</b>                    | 0,4               | <b>55</b>  | 90  | 18 | 1                      | 81   | 4,3            | 9,7            | 1,4            |
| <b>N1011-K-M1-SP</b>                          | 0,44              | <b>55</b>  | 90  | 18 | 1                      | 80,5 | 4,3            | 9,7            | 1,4            |
| <b>N1011-K-PVPA1-SP<sup>4)</sup></b>          | 0,34              | <b>55</b>  | 90  | 18 | 1                      | 80,5 | 4,3            | 9,7            | 1,4            |
| <b>HCN1011-K-PVPA1-SP<sup>4)</sup></b>        | 0,34              | <b>55</b>  | 90  | 18 | 1                      | 80,5 | 4,3            | 9,7            | 1,4            |
| <b>HCN1011-K-PVPA1-SP-H193<sup>4)</sup></b>   | 0,32              | <b>55</b>  | 90  | 18 | 1                      | 80,5 | 4,3            | 9,7            | 1,4            |
| <b>N1912-K-M1-SP</b>                          | 0,22              | <b>60</b>  | 85  | 13 | 0,6                    | 78,5 | –              | –              | –              |
| <b>N1012-D-K-TVP-SP-XL</b>                    | 0,43              | <b>60</b>  | 95  | 18 | 1                      | 86,1 | 4,3            | 9,7            | 1,4            |
| <b>N1012-K-M1-SP</b>                          | 0,47              | <b>60</b>  | 95  | 18 | 1                      | 85,5 | 4,3            | 9,7            | 1,4            |
| <b>N1012-K-PVPA1-SP<sup>4)</sup></b>          | 0,37              | <b>60</b>  | 95  | 18 | 1                      | 85,5 | 4,3            | 9,7            | 1,4            |
| <b>HCN1012-K-PVPA1-SP<sup>4)</sup></b>        | 0,37              | <b>60</b>  | 95  | 18 | 1                      | 85,5 | 4,3            | 9,7            | 1,4            |
| <b>HCN1012-K-PVPA1-SP-H193<sup>4)</sup></b>   | 0,36              | <b>60</b>  | 95  | 18 | 1                      | 85,5 | 4,3            | 9,7            | 1,4            |
| <b>N1913-K-M1-SP</b>                          | 0,24              | <b>65</b>  | 90  | 13 | 0,6                    | 83,5 | –              | –              | –              |
| <b>N1013-D-K-TVP-SP-XL</b>                    | 0,45              | <b>65</b>  | 100 | 18 | 1                      | 91   | 4              | 10,4           | 1,4            |
| <b>N1013-K-M1-SP</b>                          | 0,5               | <b>65</b>  | 100 | 18 | 1                      | 90,5 | 4              | 10,4           | 1,4            |
| <b>N1013-C-K-PVPA1-SP<sup>4)</sup></b>        | 0,4               | <b>65</b>  | 100 | 18 | 1                      | 91   | 4              | 10,4           | 1,4            |
| <b>HCN1013-C-K-PVPA1-SP<sup>4)</sup></b>      | 0,4               | <b>65</b>  | 100 | 18 | 1                      | 91   | 4              | 10,4           | 1,4            |
| <b>HCN1013-C-K-PVPA1-SP-H193<sup>4)</sup></b> | 0,38              | <b>65</b>  | 100 | 18 | 1                      | 91   | 4              | 10,4           | 1,4            |
| <b>N1914-K-M1-SP</b>                          | 0,39              | <b>70</b>  | 100 | 16 | 0,6                    | 92   | –              | –              | –              |
| <b>N1014-D-K-TVP-SP-XL</b>                    | 0,64              | <b>70</b>  | 110 | 20 | 1                      | 100  | 4              | 11,6           | 1,4            |
| <b>N1014-K-M1-SP</b>                          | 0,69              | <b>70</b>  | 110 | 20 | 1                      | 100  | 4              | 11,6           | 1,4            |
| <b>N1014-K-PVPA1-SP<sup>4)</sup></b>          | 0,52              | <b>70</b>  | 110 | 20 | 1                      | 100  | 4              | 11,6           | 1,4            |
| <b>HCN1014-K-PVPA1-SP<sup>4)</sup></b>        | 0,52              | <b>70</b>  | 110 | 20 | 1                      | 100  | 4              | 11,6           | 1,4            |
| <b>HCN1014-K-PVPA1-SP-H193<sup>4)</sup></b>   | 0,49              | <b>70</b>  | 110 | 20 | 1                      | 100  | 4              | 11,6           | 1,4            |

<sup>1)</sup> Explanation of short designations, see page 198.

The bearings are also available in the following designs:

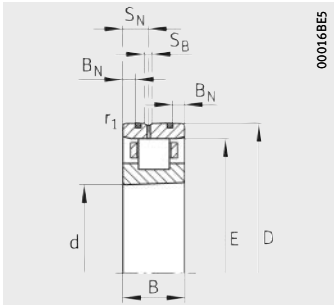
- With cylindrical bore (without suffix K),  
Ordering example: N1011-D-TVP-SP-XL
- As Direct Lube design (suffix DLR),  
Ordering examples: N1011-K-DLR-M1-SP and N1011-K-DLR-PVPA1-SP.

<sup>2)</sup> Axial displacement of outer ring from central position.

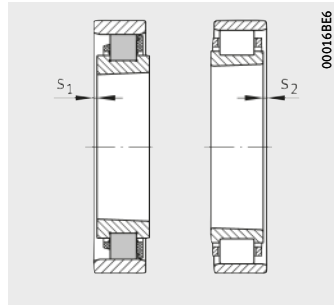
<sup>3)</sup> Minimal quantity oil lubrication.

<sup>4)</sup> Also available as thermally robust design (suffix TR),  
Ordering example: N1011-K-TR-PVPA1-SP.

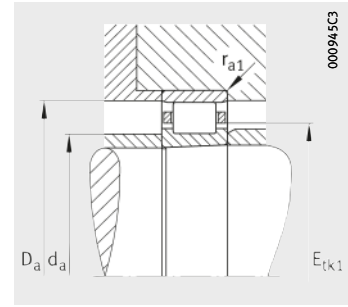




Direct Lube



Axial displacement



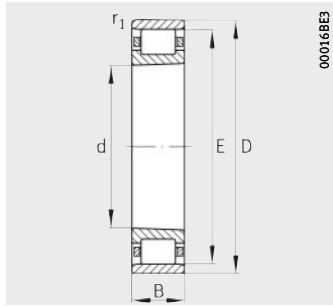
Mounting dimensions

| Axial displacement <sup>2)</sup> |                | Mounting dimensions   |                       |                          |                          |                         | Basic load ratings          |                               | Limiting speeds                            |   |
|----------------------------------|----------------|-----------------------|-----------------------|--------------------------|--------------------------|-------------------------|-----------------------------|-------------------------------|--|---|
| s <sub>1</sub>                   | s <sub>2</sub> | d <sub>a</sub><br>h12 | D <sub>a</sub><br>H12 | E <sub>tk1</sub><br>nom. | E <sub>tk2</sub><br>nom. | r <sub>a1</sub><br>max. | dyn.<br>C <sub>r</sub><br>N | stat.<br>C <sub>0r</sub><br>N | n <sub>G</sub> grease<br>min <sup>-1</sup> | n <sub>G</sub> oil <sup>3)</sup><br>min <sup>-1</sup> |
| 1,9                              | 1,9            | 61,5                  | 74                    | 72                       | –                        | 0,6                     | 27 000                      | 35 000                        | 14 000                                     | 16 000  |
| 3,4                              | 3,4            | 65                    | 82,2                  | 79,3                     | –                        | 1                       | 48 000                      | 48 500                        | 13 000                                     | 15 000  |
| 2,5                              | 2,5            | 64,5                  | 81,8                  | 78,5                     | –                        | 1                       | 42 000                      | 50 000                        | 12 000                                     | 14 000  |
| 1,4                              | 3              | 64,5                  | 81,8                  | 78,5                     | 68,8                     | 1                       | 40 500                      | 48 000                        | 20 000                                     | 24 000  |
| 1,4                              | 3              | 64,5                  | 81,8                  | 78,5                     | 68,8                     | 1                       | 40 500                      | 45 500                        | 22 000                                     | 26 000  |
| 1,4                              | 3              | 64,5                  | 81,8                  | 78,5                     | 68,8                     | 1                       | 24 100                      | 22 700                        | 26 000                                     | 30 000  |
| 1,9                              | 1,9            | 66,5                  | 79                    | 77                       | –                        | 0,6                     | 26 000                      | 34 000                        | 13 000                                     | 15 000  |
| 3,4                              | 3,4            | 70,1                  | 87,3                  | 84,4                     | –                        | 1                       | 51 000                      | 53 000                        | 12 000                                     | 14 000  |
| 2,5                              | 2,5            | 69,5                  | 86,8                  | 83,5                     | –                        | 1                       | 44 000                      | 55 000                        | 11 000                                     | 13 000  |
| 1,25                             | 3              | 69,5                  | 86,8                  | 83,5                     | 73,8                     | 1                       | 43 000                      | 53 000                        | 18 000                                     | 20 000  |
| 1,25                             | 3              | 69,5                  | 86,8                  | 83,5                     | 73,8                     | 1                       | 43 000                      | 50 000                        | 20 000                                     | 24 000  |
| 1,25                             | 3              | 69,5                  | 86,8                  | 83,5                     | 73,8                     | 1                       | 25 500                      | 25 000                        | 24 000                                     | 28 000  |
| 1,9                              | 1,9            | 71,5                  | 84                    | 82                       | –                        | 0,6                     | 29 500                      | 40 000                        | 12 000                                     | 14 000  |
| 3,4                              | 3,4            | 75                    | 92,2                  | 89,3                     | –                        | 1                       | 53 000                      | 58 000                        | 12 000                                     | 14 000  |
| 2,5                              | 2,5            | 74,5                  | 91,8                  | 88,5                     | –                        | 1                       | 45 000                      | 58 000                        | 11 000                                     | 13 000  |
| 1,4                              | 2,5            | 75                    | 92,3                  | 88,5                     | 77,8                     | 1                       | 45 000                      | 58 000                        | 17 000                                     | 19 000  |
| 1,4                              | 2,5            | 75                    | 92,3                  | 88,5                     | 77,8                     | 1                       | 43 000                      | 50 000                        | 17 000                                     | 19 000  |
| 1,4                              | 2,5            | 75                    | 92,3                  | 88,5                     | 77,8                     | 1                       | 27 000                      | 27 000                        | 22 000                                     | 26 000  |
| 2,3                              | 2,3            | 78                    | 93                    | 90,3                     | –                        | 0,6                     | 36 500                      | 49 000                        | 11 000                                     | 13 000  |
| 3,8                              | 3,8            | 82                    | 101,3                 | 98,2                     | –                        | 1                       | 66 000                      | 72 000                        | 10 000                                     | 12 000  |
| 2,5                              | 2,5            | 80                    | 101,3                 | 97,5                     | –                        | 1                       | 65 000                      | 81 000                        | 10 000                                     | 12 000  |
| 1,25                             | 3,3            | 80                    | 101,3                 | 97,5                     | 85,4                     | 1                       | 63 000                      | 77 000                        | 16 000                                     | 18 000  |
| 1,25                             | 3,3            | 80                    | 101,3                 | 97,5                     | 85,4                     | 1                       | 61 000                      | 70 000                        | 18 000                                     | 20 000  |
| 1,25                             | 3,3            | 80                    | 101,3                 | 97,5                     | 85,4                     | 1                       | 36 500                      | 35 000                        | 20 000                                     | 24 000  |

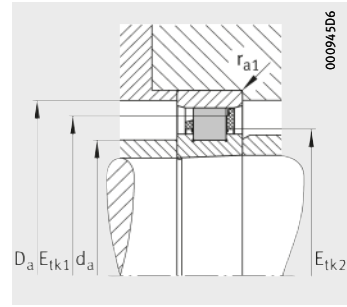


# Super precision cylindrical roller bearings

Single row  
Steel or ceramic rollers



N10, N19  
Steel rollers



HCN10  
Ceramic rollers

**Dimension table** (continued) · Dimensions in mm

| Designation <sup>1)</sup>                   | Mass<br>m<br>≈ kg | Dimensions |     |    |                        |       |                |                |                |
|---|-------------------|------------|-----|----|------------------------|-------|----------------|----------------|----------------|
|   |                   | d          | D   | B  | r <sub>1</sub><br>min. | E     | B <sub>N</sub> | S <sub>N</sub> | S <sub>B</sub> |
| <b>N1915-K-M1-SP</b>                        | 0,41              | <b>75</b>  | 105 | 16 | 0,6                    | 97    | –              | –              | –              |
| <b>N1015-D-K-TVP-SP-XL</b>                  | 0,67              | <b>75</b>  | 115 | 20 | 1                      | 105   | 4              | 11,6           | 1,4            |
| <b>N1015-K-M1-SP</b>                        | 0,81              | <b>75</b>  | 115 | 20 | 1                      | 105   | 4              | 11,6           | 1,4            |
| <b>N1015-K-PVPA1-SP<sup>4)</sup></b>        | 0,56              | <b>75</b>  | 115 | 20 | 1                      | 105   | 4              | 11,6           | 1,4            |
| <b>HCN1015-K-PVPA1-SP<sup>4)</sup></b>      | 0,56              | <b>75</b>  | 115 | 20 | 1                      | 105   | 4              | 11,6           | 1,4            |
| <b>HCN1015-K-PVPA1-SP-H193<sup>4)</sup></b> | 0,54              | <b>75</b>  | 115 | 20 | 1                      | 105   | 4              | 11,6           | 1,4            |
| <b>N1916-K-M1-SP</b>                        | 0,43              | <b>80</b>  | 110 | 16 | 0,6                    | 102   | –              | –              | –              |
| <b>N1016-D-K-TVP-SP-XL</b>                  | 0,9               | <b>80</b>  | 125 | 22 | 1                      | 113   | 4,7            | 12,2           | 2,2            |
| <b>N1016-K-M1-SP</b>                        | 0,97              | <b>80</b>  | 125 | 22 | 1                      | 113,5 | 4,7            | 12,2           | 2,2            |
| <b>N1016-K-PVPA1-SP<sup>4)</sup></b>        | 0,76              | <b>80</b>  | 125 | 22 | 1                      | 113,5 | 4,7            | 12,2           | 2,2            |
| <b>HCN1016-K-PVPA1-SP<sup>4)</sup></b>      | 0,76              | <b>80</b>  | 125 | 22 | 1                      | 113,5 | 4,7            | 12,2           | 2,2            |
| <b>HCN1016-K-PVPA1-SP-H193<sup>4)</sup></b> | 0,66              | <b>80</b>  | 125 | 22 | 1                      | 113,5 | 4,7            | 12,2           | 2,2            |
| <b>N1917-K-M1-SP</b>                        | 0,61              | <b>85</b>  | 120 | 18 | 1                      | 110,5 | –              | –              | –              |
| <b>N1017-D-K-TVP-SP-XL</b>                  | 0,95              | <b>85</b>  | 130 | 22 | 1                      | 118   | 4,7            | 12,2           | 2,2            |
| <b>N1017-K-M1-SP</b>                        | 1,04              | <b>85</b>  | 130 | 22 | 1                      | 118,5 | 4,7            | 12,2           | 2,2            |
| <b>N1017-K-PVPA1-SP<sup>4)</sup></b>        | 0,89              | <b>85</b>  | 130 | 22 | 1                      | 118,5 | 4,7            | 12,2           | 2,2            |
| <b>HCN1017-K-PVPA1-SP<sup>4)</sup></b>      | 0,89              | <b>85</b>  | 130 | 22 | 1                      | 118,5 | 4,7            | 12,2           | 2,2            |
| <b>HCN1017-K-PVPA1-SP-H193<sup>4)</sup></b> | 0,75              | <b>85</b>  | 130 | 22 | 1                      | 118,5 | 4,7            | 12,2           | 2,2            |
| <b>N1918-K-M1-SP</b>                        | 0,64              | <b>90</b>  | 125 | 18 | 1                      | 115,5 | –              | –              | –              |
| <b>N1018-D-K-TVP-SP-XL</b>                  | 1,23              | <b>90</b>  | 140 | 24 | 1,1                    | 127   | 5,5            | 14,5           | 2,2            |
| <b>N1018-K-M1-SP</b>                        | 1,34              | <b>90</b>  | 140 | 24 | 1,1                    | 127   | 5,5            | 14,5           | 2,2            |
| <b>N1018-K-PVPA1-SP<sup>4)</sup></b>        | 1,06              | <b>90</b>  | 140 | 24 | 1,1                    | 127   | 5,5            | 14,5           | 2,2            |
| <b>HCN1018-K-PVPA1-SP<sup>4)</sup></b>      | 1,06              | <b>90</b>  | 140 | 24 | 1,1                    | 127   | 5,5            | 14,5           | 2,2            |
| <b>HCN1018-K-PVPA1-SP-H193<sup>4)</sup></b> | 0,99              | <b>90</b>  | 140 | 24 | 1,1                    | 127   | 5,5            | 14,5           | 2,2            |

<sup>1)</sup> Explanation of short designations, see page 198.

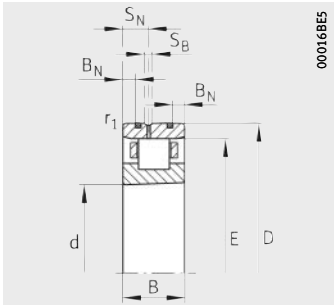
The bearings are also available in the following designs:

- With cylindrical bore (without suffix K),  
Ordering example: N1015-D-TVP-SP-XL
- As Direct Lube design (suffix DLR),  
Ordering examples: N1015-K-DLR-M1-SP and N1015-K-DLR-PVPA1-SP.

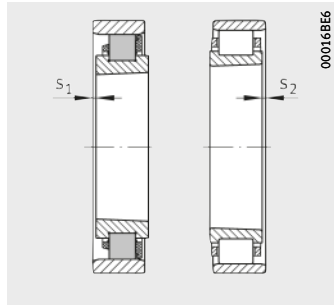
<sup>2)</sup> Axial displacement of outer ring from central position.

<sup>3)</sup> Minimal quantity oil lubrication.

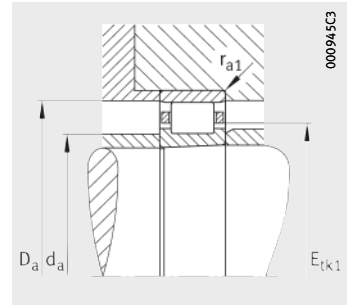
<sup>4)</sup> Also available as thermally robust design (suffix TR),  
Ordering example: N1015-K-TR-PVPA1-SP.



Direct Lube



Axial displacement



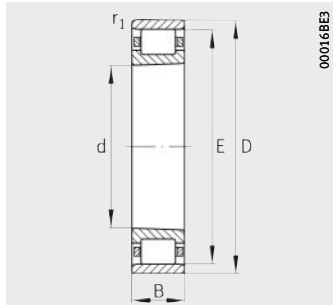
Mounting dimensions

| Axial displacement <sup>2)</sup> |                | Mounting dimensions   |                       |                          |                          |                         | Basic load ratings          |                               | Limiting speeds                            |   |
|----------------------------------|----------------|-----------------------|-----------------------|--------------------------|--------------------------|-------------------------|-----------------------------|-------------------------------|--|---|
| s <sub>1</sub>                   | s <sub>2</sub> | d <sub>a</sub><br>h12 | D <sub>a</sub><br>H12 | E <sub>tk1</sub><br>nom. | E <sub>tk2</sub><br>nom. | r <sub>a1</sub><br>max. | dyn.<br>C <sub>r</sub><br>N | stat.<br>C <sub>0r</sub><br>N | n <sub>G</sub> grease<br>min <sup>-1</sup> | n <sub>G</sub> oil <sup>3)</sup><br>min <sup>-1</sup> |
| 2,3                              | 2,3            | 83                    | 98                    | 95,3                     | –                        | 0,6                     | 38 000                      | 53 000                        | 10 000                                     | 12 000  |
| 3,8                              | 3,8            | 87                    | 106,3                 | 103,2                    | –                        | 1                       | 65 000                      | 73 000                        | 10 000                                     | 12 000  |
| 2,5                              | 2,5            | 85                    | 106,3                 | 102,5                    | –                        | 1                       | 66 000                      | 85 000                        | 9 500                                      | 11 000  |
| 1                                | 3              | 85                    | 106,3                 | 102,5                    | 90,4                     | 1                       | 66 000                      | 85 000                        | 15 000                                     | 17 000  |
| 1                                | 3              | 85                    | 106,3                 | 102,5                    | 90,4                     | 1                       | 65 000                      | 77 000                        | 17 000                                     | 19 000  |
| 1                                | 3              | 85                    | 106,3                 | 102,5                    | 90,4                     | 1                       | 38 500                      | 38 500                        | 19 000                                     | 22 000  |
| 2,3                              | 2,3            | 88                    | 103                   | 100,3                    | –                        | 0,6                     | 39 500                      | 56 000                        | 9 500                                      | 11 000  |
| 4,1                              | 4,1            | 93                    | 114,4                 | 111,4                    | –                        | 1                       | 81 000                      | 91 000                        | 9 000                                      | 11 000  |
| 3                                | 3              | 91,5                  | 115                   | 110,8                    | –                        | 1                       | 77 000                      | 99 000                        | 8 500                                      | 9 500   |
| 1,1                              | 3,5            | 91,5                  | 115                   | 110,8                    | 97,4                     | 1                       | 77 000                      | 99 000                        | 14 000                                     | 16 000  |
| 1,1                              | 3,5            | 91,5                  | 115                   | 110,8                    | 97,4                     | 1                       | 77 000                      | 93 000                        | 15 000                                     | 17 000  |
| 1,1                              | 3,5            | 91,5                  | 115                   | 110,8                    | 97,4                     | 1                       | 45 500                      | 46 500                        | 18 000                                     | 20 000  |
| 2,5                              | 2,5            | 94,5                  | 112                   | 108,5                    | –                        | 1                       | 49 500                      | 70 000                        | 8 500                                      | 9 500   |
| 4,1                              | 4,1            | 98                    | 119,4                 | 116,3                    | –                        | 1                       | 80 000                      | 91 000                        | 8 500                                      | 10 000  |
| 3                                | 3              | 96,5                  | 120                   | 115,8                    | –                        | 1                       | 79 000                      | 103 000                       | 8 000                                      | 9 000   |
| 1,5                              | 2,7            | 96,5                  | 120                   | 115,8                    | 102,4                    | 1                       | 76 000                      | 99 000                        | 13 000                                     | 15 000  |
| 1,5                              | 2,7            | 96,5                  | 120                   | 115,8                    | 102,4                    | 1                       | 76 000                      | 93 000                        | 15 000                                     | 17 000  |
| 1,5                              | 2,7            | 96,5                  | 120                   | 115,8                    | 102,4                    | 1                       | 45 500                      | 46 500                        | 17 000                                     | 19 000  |
| 2,5                              | 2,5            | 99,5                  | 117                   | 113,5                    | –                        | 1                       | 51 000                      | 75 000                        | 8 500                                      | 9 500   |
| 4,4                              | 4,4            | 105                   | 128,5                 | 124,9                    | –                        | 1,1                     | 95 000                      | 108 000                       | 8 000                                      | 9 500   |
| 3,2                              | 3,2            | 103                   | 128,6                 | 124                      | –                        | 1,1                     | 94 000                      | 124 000                       | 7 500                                      | 8 500   |
| 1,2                              | 3,7            | 103                   | 128,6                 | 124                      | 109,4                    | 1,1                     | 91 000                      | 119 000                       | 12 000                                     | 14 000  |
| 1,2                              | 3,7            | 103                   | 128,6                 | 124                      | 109,4                    | 1,1                     | 91 000                      | 112 000                       | 13 000                                     | 15 000  |
| 1,2                              | 3,7            | 103                   | 128,6                 | 124                      | 109,4                    | 1,1                     | 54 000                      | 56 000                        | 15 000                                     | 17 000  |

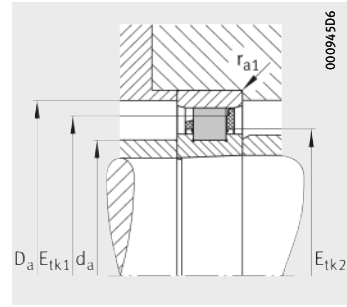


# Super precision cylindrical roller bearings

Single row  
Steel or ceramic rollers



N10, N19  
Steel rollers



HCN10  
Ceramic rollers

**Dimension table** (continued) · Dimensions in mm

| Designation <sup>1)</sup>                   | Mass<br>m<br>≈ kg | Dimensions |     |    |                        |       |                |                |                |
|---|-------------------|------------|-----|----|------------------------|-------|----------------|----------------|----------------|
|   |                   | d          | D   | B  | r <sub>1</sub><br>min. | E     | B <sub>N</sub> | S <sub>N</sub> | S <sub>B</sub> |
| Series 10 and 19                            |                   |            |     |    |                        |       |                |                |                |
| <b>N1919-K-M1-SP</b>                        | 0,67              | <b>95</b>  | 130 | 18 | 1                      | 120,5 | –              | –              | –              |
| <b>N1019-D-K-TVP-SP-XL</b>                  | 1,29              | <b>95</b>  | 145 | 24 | 1,1                    | 132   | 5,5            | 14,5           | 2,2            |
| <b>N1019-K-M1-SP</b>                        | 1,4               | <b>95</b>  | 145 | 24 | 1,1                    | 132   | 5,5            | 14,5           | 2,2            |
| <b>N1019-K-PVPA1-SP<sup>4)</sup></b>        | 1,2               | <b>95</b>  | 145 | 24 | 1,1                    | 132   | 5,5            | 14,5           | 2,2            |
| <b>HCN1019-K-PVPA1-SP<sup>4)</sup></b>      | 1,2               | <b>95</b>  | 145 | 24 | 1,1                    | 132   | 5,5            | 14,5           | 2,2            |
| <b>HCN1019-K-PVPA1-SP-H193<sup>4)</sup></b> | 1,04              | <b>95</b>  | 145 | 24 | 1,1                    | 132   | 5,5            | 14,5           | 2,2            |
| <b>N1920-K-M1-SP</b>                        | 0,92              | <b>100</b> | 140 | 20 | 1                      | 130   | –              | –              | –              |
| <b>N1020-D-K-TVP-SP-XL</b>                  | 1,34              | <b>100</b> | 150 | 24 | 1,1                    | 137   | 5,5            | 14,5           | 2,2            |
| <b>N1020-K-M1-SP</b>                        | 1,46              | <b>100</b> | 150 | 24 | 1,1                    | 137   | 5,5            | 14,5           | 2,2            |
| <b>N1020-K-PVPA1-SP<sup>4)</sup></b>        | 1,2               | <b>100</b> | 150 | 24 | 1,1                    | 137   | 5,5            | 14,5           | 2,2            |
| <b>HCN1020-K-PVPA1-SP<sup>4)</sup></b>      | 1,2               | <b>100</b> | 150 | 24 | 1,1                    | 137   | 5,5            | 14,5           | 2,2            |
| <b>HCN1020-K-PVPA1-SP-H193<sup>4)</sup></b> | 1,07              | <b>100</b> | 150 | 24 | 1,1                    | 137   | 5,5            | 14,5           | 2,2            |
| <b>N1921-K-M1-SP</b>                        | 0,96              | <b>105</b> | 145 | 20 | 1                      | 135   | –              | –              | –              |
| <b>N1021-D-K-TVP-SP-XL</b>                  | 1,67              | <b>105</b> | 160 | 26 | 1,1                    | 146   | 6              | 15,2           | 2,2            |
| <b>N1021-K-M1-SP</b>                        | 1,82              | <b>105</b> | 160 | 26 | 1,1                    | 145,5 | 6              | 15,2           | 2,2            |
| <b>N1021-K-PVPA1-SP<sup>4)</sup></b>        | 1,81              | <b>105</b> | 160 | 26 | 1,1                    | 145,5 | 6              | 15,2           | 2,2            |
| <b>HCN1021-K-PVPA1-SP<sup>4)</sup></b>      | 1,81              | <b>105</b> | 160 | 26 | 1,1                    | 145,5 | 6              | 15,2           | 2,2            |
| <b>HCN1021-K-PVPA1-SP-H193<sup>4)</sup></b> | 1,79              | <b>105</b> | 160 | 26 | 1,1                    | 145,5 | 6              | 15,2           | 2,2            |
| <b>N1922-K-M1-SP</b>                        | 0,99              | <b>110</b> | 150 | 20 | 1                      | 140   | –              | –              | –              |
| <b>N1022-D-K-TVP-SP-XL</b>                  | 2,07              | <b>110</b> | 170 | 28 | 1,1                    | 155   | 6              | 16,2           | 2,2            |
| <b>N1022-K-M1-SP</b>                        | 2,3               | <b>110</b> | 170 | 28 | 1,1                    | 155   | 6              | 16,2           | 2,2            |
| <b>N1022-K-PVPA1-SP<sup>4)</sup></b>        | 1,9               | <b>110</b> | 170 | 28 | 1,1                    | 155   | 6              | 16,2           | 2,2            |
| <b>HCN1022-K-PVPA1-SP<sup>4)</sup></b>      | 1,9               | <b>110</b> | 170 | 28 | 1,1                    | 155   | 6              | 16,2           | 2,2            |
| <b>HCN1022-K-PVPA1-SP-H193<sup>4)</sup></b> | 1,85              | <b>110</b> | 170 | 28 | 1,1                    | 155   | 6              | 16,2           | 2,2            |

<sup>1)</sup> Explanation of short designations, see page 198.

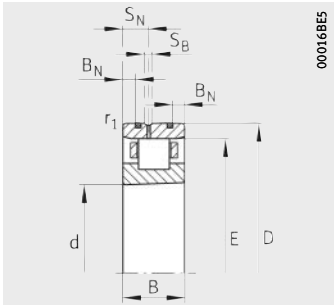
The bearings are also available in the following designs:

- With cylindrical bore (without suffix K),  
Ordering example: N1019-D-TVP-SP-XL
- As Direct Lube design (suffix DLR),  
Ordering examples: N1019-K-DLR-M1-SP and N1019-K-DLR-PVPA1-SP.

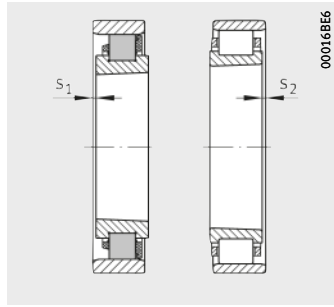
<sup>2)</sup> Axial displacement of outer ring from central position.

<sup>3)</sup> Minimal quantity oil lubrication.

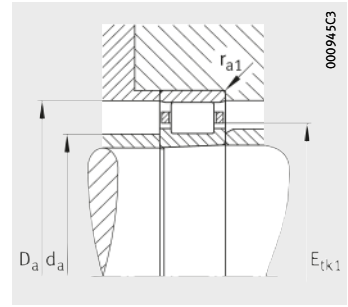
<sup>4)</sup> Also available as thermally robust design (suffix TR),  
Ordering example: N1019-K-TR-PVPA1-SP.



Direct Lube



Axial displacement



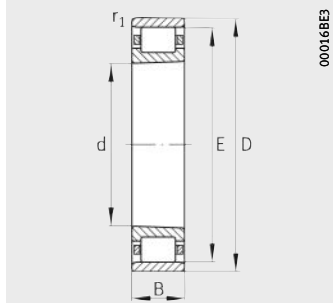
Mounting dimensions

| Axial displacement <sup>2)</sup> |                | Mounting dimensions   |                       |                          |                          |                         | Basic load ratings          |                               | Limiting speeds                            |   |
|----------------------------------|----------------|-----------------------|-----------------------|--------------------------|--------------------------|-------------------------|-----------------------------|-------------------------------|--|---|
| s <sub>1</sub>                   | s <sub>2</sub> | d <sub>a</sub><br>h12 | D <sub>a</sub><br>H12 | E <sub>tk1</sub><br>nom. | E <sub>tk2</sub><br>nom. | r <sub>a1</sub><br>max. | dyn.<br>C <sub>r</sub><br>N | stat.<br>C <sub>0r</sub><br>N | n <sub>G</sub> grease<br>min <sup>-1</sup> | n <sub>G</sub> oil <sup>3)</sup><br>min <sup>-1</sup> |
| 2,5                              | 2,5            | 104,5                 | 122                   | 118,5                    | –                        | 1                       | 52 000                      | 78 000                        | 8 000                                      | 9 000   |
| 4,4                              | 4,4            | 110                   | 133,5                 | 129,8                    | –                        | 1,1                     | 99 000                      | 117 000                       | 7 500                                      | 9 000   |
| 3,2                              | 3,2            | 108                   | 133,6                 | 129                      | –                        | 1,1                     | 96 000                      | 130 000                       | 7 000                                      | 8 000   |
| 1,2                              | 3,7            | 108                   | 133,6                 | 129                      | 114,4                    | 1,1                     | 96 000                      | 130 000                       | 12 000                                     | 14 000  |
| 1,2                              | 3,7            | 108                   | 133,6                 | 129                      | 114,4                    | 1,1                     | 96 000                      | 122 000                       | 13 000                                     | 15 000  |
| 1,2                              | 3,7            | 108                   | 133,6                 | 129                      | 114,4                    | 1,1                     | 57 000                      | 61 000                        | 15 000                                     | 17 000  |
| 2,5                              | 2,5            | 110                   | 132                   | 127,5                    | –                        | 1                       | 77 000                      | 113 000                       | 7 000                                      | 8 000   |
| 4,4                              | 4,4            | 115                   | 138,5                 | 134,8                    | –                        | 1,1                     | 99 000                      | 118 000                       | 7 500                                      | 9 000   |
| 3,2                              | 3,2            | 113                   | 138,6                 | 134                      | –                        | 1,1                     | 98 000                      | 135 000                       | 6 700                                      | 7 500   |
| 1,1                              | 3,5            | 113                   | 138,6                 | 134                      | 119,4                    | 1,1                     | 95 000                      | 130 000                       | 11 000                                     | 13 000  |
| 1,1                              | 3,5            | 113                   | 138,6                 | 134                      | 119,4                    | 1,1                     | 95 000                      | 123 000                       | 12 000                                     | 14 000  |
| 1,1                              | 3,5            | 113                   | 138,6                 | 134                      | 119,4                    | 1,1                     | 57 000                      | 61 000                        | 14 000                                     | 16 000  |
| 2,5                              | 2,5            | 115                   | 137                   | 132,5                    | –                        | 1                       | 79 000                      | 117 000                       | 6 700                                      | 7 500   |
| 4,5                              | 4,5            | 120                   | 147,5                 | 143,5                    | –                        | 1,1                     | 132 000                     | 154 000                       | 7 000                                      | 8 000   |
| 3,4                              | 3,4            | 119,5                 | 147,2                 | 142,3                    | –                        | 1,1                     | 112 000                     | 154 000                       | 6 300                                      | 7 000   |
| 0,6                              | 3,2            | 119,5                 | 147,2                 | 142,3                    | 126,5                    | 1,1                     | 112 000                     | 154 000                       | 10 000                                     | 12 000  |
| 0,6                              | 3,2            | 119,5                 | 147,2                 | 142,3                    | 126,5                    | 1,1                     | 111 000                     | 144 000                       | 11 000                                     | 13 000  |
| 0,6                              | 3,2            | 119,5                 | 147,2                 | 142,3                    | 126,5                    | 1,1                     | 66 000                      | 72 000                        | 13 000                                     | 15 000  |
| 2,5                              | 2,5            | 120                   | 142                   | 137,5                    | –                        | 1                       | 80 000                      | 121 000                       | 6 700                                      | 7 500   |
| 4,8                              | 4,8            | 127                   | 156,6                 | 152,4                    | –                        | 1,1                     | 153 000                     | 180 000                       | 6 300                                      | 7 500   |
| 3,4                              | 3,4            | 125                   | 156,7                 | 151,3                    | –                        | 1,1                     | 141 000                     | 180 000                       | 6 000                                      | 6 700   |
| 1                                | 4              | 125                   | 156,7                 | 151,3                    | 133,1                    | 1,1                     | 141 000                     | 180 000                       | 9 500                                      | 11 000  |
| 1                                | 4              | 125                   | 156,7                 | 151,3                    | 133,1                    | 1,1                     | 141 000                     | 180 000                       | 11 000                                     | 13 000  |
| 1                                | 4              | 125                   | 156,7                 | 151,3                    | 133,1                    | 1,1                     | 84 000                      | 90 000                        | 12 000                                     | 14 000  |

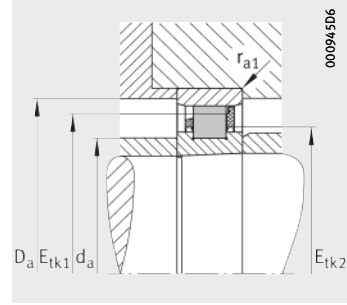


# Super precision cylindrical roller bearings

Single row  
Steel or ceramic rollers



N10, N19  
Steel rollers



HCN10  
Ceramic rollers

**Dimension table** (continued) · Dimensions in mm

| Designation <sup>1)</sup>                   | Mass<br>m<br>≈ kg | Dimensions |     |    |                        |       |                |                |                |
|---|-------------------|------------|-----|----|------------------------|-------|----------------|----------------|----------------|
|   |                   | d          | D   | B  | r <sub>1</sub><br>min. | E     | B <sub>N</sub> | S <sub>N</sub> | S <sub>B</sub> |
| Series 10 and 19                            |                   |            |     |    |                        |       |                |                |                |
| <b>N1924-K-M1-SP</b>                        | 1,34              | <b>120</b> | 165 | 22 | 1                      | 153,5 | –              | –              | –              |
| <b>N1024-D-K-TVP-SP-XL</b>                  | 2,22              | <b>120</b> | 180 | 28 | 1,1                    | 165   | 6              | 16,2           | 2,2            |
| <b>N1024-K-M1-SP</b>                        | 2,47              | <b>120</b> | 180 | 28 | 1,1                    | 165   | 6              | 16,2           | 2,2            |
| <b>N1024-K-PVPA1-SP<sup>4)</sup></b>        | 2,05              | <b>120</b> | 180 | 28 | 1,1                    | 165   | 6              | 16,2           | 2,2            |
| <b>HCN1024-K-PVPA1-SP<sup>4)</sup></b>      | 2,05              | <b>120</b> | 180 | 28 | 1,1                    | 165   | 6              | 16,2           | 2,2            |
| <b>HCN1024-K-PVPA1-SP-H193<sup>4)</sup></b> | 1,95              | <b>120</b> | 180 | 28 | 1,1                    | 165   | 6              | 16,2           | 2,2            |
| <b>N1926-K-M1-SP</b>                        | 1,8               | <b>130</b> | 180 | 24 | 1,1                    | 167   | –              | –              | –              |
| <b>N1026-K-M1-SP</b>                        | 3,72              | <b>130</b> | 200 | 33 | 1,1                    | 182   | –              | –              | –              |
| <b>N1928-K-M1-SP</b>                        | 1,92              | <b>140</b> | 190 | 24 | 1,1                    | 177   | –              | –              | –              |
| <b>N1028-K-M1-SP</b>                        | 3,85              | <b>140</b> | 210 | 33 | 1,1                    | 192   | –              | –              | –              |
| <b>N1930-K-M1-SP</b>                        | 2,95              | <b>150</b> | 210 | 28 | 1,1                    | 194   | –              | –              | –              |
| <b>N1030-K-M1-SP</b>                        | 4,81              | <b>150</b> | 225 | 35 | 1,5                    | 205,5 | –              | –              | –              |
| <b>N1932-K-M1-SP</b>                        | 3,1               | <b>160</b> | 220 | 28 | 1,1                    | 204   | –              | –              | –              |
| <b>N1032-K-M1-SP</b>                        | 5,76              | <b>160</b> | 240 | 38 | 1,5                    | 220   | –              | –              | –              |
| <b>N1934-K-M1-SP</b>                        | 3,28              | <b>170</b> | 230 | 28 | 1,1                    | 214   | –              | –              | –              |
| <b>N1034-K-M1-SP</b>                        | 7,77              | <b>170</b> | 260 | 42 | 2,1                    | 237   | –              | –              | –              |
| <b>N1936-K-M1-SP</b>                        | 4,81              | <b>180</b> | 250 | 33 | 1,1                    | 232   | –              | –              | –              |
| <b>N1036-K-M1-SP</b>                        | 10,2              | <b>180</b> | 280 | 46 | 2,1                    | 255   | –              | –              | –              |

<sup>1)</sup> Explanation of short designations, see page 198.

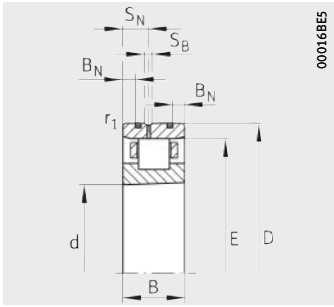
The bearings are also available in the following designs:

- With cylindrical bore (without suffix K),  
Ordering example: N1024-D-TVP-SP-XL
- As Direct Lube design (suffix DLR),  
Ordering examples: N1024-K-DLR-M1-SP and N1024-K-DLR-PVPA1-SP.

<sup>2)</sup> Axial displacement of outer ring from central position.

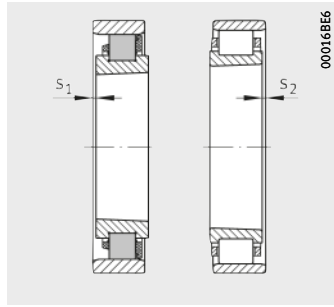
<sup>3)</sup> Minimal quantity oil lubrication.

<sup>4)</sup> Also available as thermally robust design (suffix TR),  
Ordering example: N1024-K-TR-PVPA1-SP.



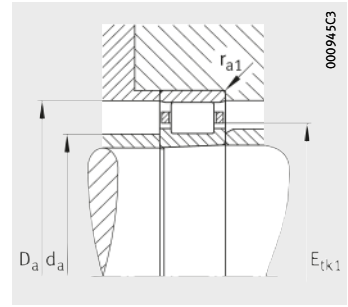
000168E5

Direct Lube



000168E6

Axial displacement



000945C3

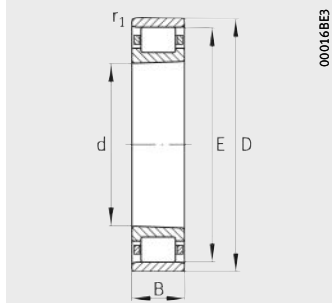
Mounting dimensions

| Axial displacement <sup>2)</sup> |                | Mounting dimensions   |                       |                          |                          |                         | Basic load ratings          |                               | Limiting speeds                            |   |
|----------------------------------|----------------|-----------------------|-----------------------|--------------------------|--------------------------|-------------------------|-----------------------------|-------------------------------|--|---|
| s <sub>1</sub>                   | s <sub>2</sub> | d <sub>a</sub><br>h12 | D <sub>a</sub><br>H12 | E <sub>tk1</sub><br>nom. | E <sub>tk2</sub><br>nom. | r <sub>a1</sub><br>max. | dyn.<br>C <sub>r</sub><br>N | stat.<br>C <sub>0r</sub><br>N | n <sub>G</sub> grease<br>min <sup>-1</sup> | n <sub>G</sub> oil <sup>3)</sup><br>min <sup>-1</sup> |
| 3                                | 3              | 131,5                 | 156                   | 150,8                    | –                        | 1                       | 95 000                      | 144 000                       | 6 000                                      | 6 700   |
| 4,8                              | 4,8            | 137                   | 166,6                 | 162,4                    | –                        | 1,1                     | 160 000                     | 196 000                       | 6 000                                      | 7 000   |
| 3,4                              | 3,4            | 135                   | 166,7                 | 161,3                    | –                        | 1,1                     | 148 000                     | 196 000                       | 5 600                                      | 6 300   |
| 1                                | 4              | 135                   | 166,7                 | 161,3                    | 143,1                    | 1,1                     | 148 000                     | 196 000                       | 9 000                                      | 10 000  |
| 1                                | 4              | 135                   | 166,7                 | 161,3                    | 143,1                    | 1,1                     | 147 000                     | 195 000                       | 10 000                                     | 12 000  |
| 1                                | 4              | 135                   | 166,7                 | 161,3                    | 143,1                    | 1,1                     | 88 000                      | 97 000                        | 11 000                                     | 13 000  |
| 3,2                              | 3,2            | 143                   | 170                   | 164                      | –                        | 1,1                     | 110 000                     | 169 000                       | 5 300                                      | 6 000   |
| 4,2                              | 4,2            | 148                   | 184,1                 | 177,8                    | –                        | 1,1                     | 179 000                     | 250 000                       | 5 000                                      | 5 600   |
| 3,2                              | 3,2            | 153                   | 180                   | 174                      | –                        | 1,1                     | 116 000                     | 185 000                       | 4 300                                      | 4 800   |
| 4,2                              | 4,2            | 158                   | 194,1                 | 187,8                    | –                        | 1,1                     | 183 000                     | 265 000                       | 4 500                                      | 5 000   |
| 3,6                              | 3,6            | 166                   | 197                   | 190,5                    | –                        | 1,1                     | 149 000                     | 234 000                       | 4 500                                      | 5 000   |
| 4,4                              | 4,4            | 169,5                 | 207,8                 | 201                      | –                        | 1,5                     | 210 000                     | 310 000                       | 4 300                                      | 4 800   |
| 3,6                              | 3,6            | 176                   | 206                   | 200,5                    | –                        | 1,1                     | 154 000                     | 250 000                       | 4 300                                      | 4 800   |
| 4,6                              | 4,6            | 180                   | 222,4                 | 215                      | –                        | 1,5                     | 245 000                     | 355 000                       | 4 000                                      | 4 500   |
| 3,6                              | 3,6            | 186                   | 216                   | 210,5                    | –                        | 1,1                     | 159 000                     | 265 000                       | 3 800                                      | 4 300   |
| 5                                | 5              | 193                   | 239,7                 | 231,5                    | –                        | 2,1                     | 295 000                     | 435 000                       | 3 600                                      | 4 000   |
| 4,2                              | 4,2            | 198                   | 234                   | 227,8                    | –                        | 1,1                     | 207 000                     | 330 000                       | 3 600                                      | 4 000   |
| 5,6                              | 5,6            | 205                   | 257,8                 | 248,8                    | –                        | 2,1                     | 360 000                     | 520 000                       | 3 400                                      | 3 800   |

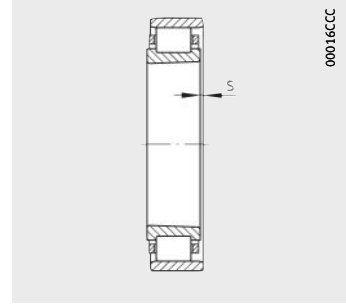


# Super precision cylindrical roller bearings

Single row  
Steel rollers



N10, N19



Axial displacement

**Dimension table** (continued) · Dimensions in mm

| Designation <sup>1)</sup> | Mass<br>m<br>≈ kg | Dimensions |     |    |                        |     | Axial displacement <sup>2)</sup><br>s |
|---------------------------|-------------------|------------|-----|----|------------------------|-----|---------------------------------------|
|                           |                   | d          | D   | B  | r <sub>1</sub><br>min. | E   |                                       |
| N1938-K-M1-SP             | 5,05              | 190        | 260 | 33 | 1,1                    | 242 | 4,2                                   |
| N1038-K-M1-SP             | 10,6              | 190        | 290 | 46 | 2,1                    | 265 | 5,6                                   |
| N1940-K-M1-SP             | 6,97              | 200        | 280 | 38 | 1,5                    | 259 | 4,8                                   |
| N1040-K-M1-SP             | 13,7              | 200        | 310 | 51 | 2,1                    | 281 | 6,4                                   |
| N1944-K-M1-SP             | 7,64              | 220        | 300 | 38 | 1,5                    | 279 | 4,8                                   |
| N1044-K-M1-SP             | 17,9              | 220        | 340 | 56 | 3                      | 310 | 6,6                                   |
| N1948-K-M1-SP             | 8,18              | 240        | 320 | 38 | 1,5                    | 299 | 4,8                                   |
| N1048-K-M1-SP             | 19,3              | 240        | 360 | 56 | 3                      | 330 | 6,6                                   |
| N1952-K-M1-SP             | 13,8              | 260        | 360 | 46 | 1,5                    | 334 | 5,4                                   |
| N1052-K-M1-SP             | 28,8              | 260        | 400 | 65 | 4                      | 364 | 8,1                                   |
| N1956-K-M1-SP             | 14,9              | 280        | 380 | 46 | 1,5                    | 354 | 5,4                                   |
| N1056-K-M1-SP             | 30,9              | 280        | 420 | 65 | 4                      | 384 | 8,1                                   |
| N1960-K-M1-SP             | 23,6              | 300        | 420 | 56 | 3                      | 390 | 6,6                                   |
| N1060-K-M1-SP             | 43,7              | 300        | 460 | 74 | 4                      | 420 | 8,7                                   |
| N1964-K-M1-SP             | 24,3              | 320        | 440 | 56 | 3                      | 410 | 6,6                                   |
| N1064-K-M1-SP             | 45,1              | 320        | 480 | 74 | 4                      | 440 | 8,7                                   |
| N1968-K-M1-SP             | 26,3              | 340        | 460 | 56 | 3                      | 430 | 6,6                                   |
| N1068-K-M1-SP             | 60,7              | 340        | 520 | 82 | 5                      | 475 | 9,3                                   |
| N1972-K-M1-SP             | 26,9              | 360        | 480 | 56 | 3                      | 450 | 6,6                                   |
| N1072-K-M1-SP             | 64,4              | 360        | 540 | 82 | 5                      | 495 | 9,3                                   |

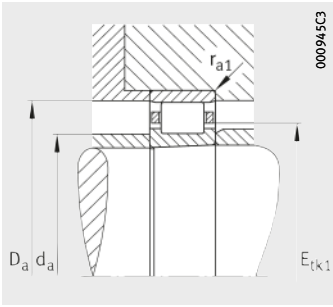
<sup>1)</sup> Explanation of short designations, see page 198.

The bearings are also available with a cylindrical bore (without suffix K), ordering example: N1938-M1-SP.

<sup>2)</sup> Axial displacement of outer ring from central position.

<sup>3)</sup> Minimal quantity oil lubrication.





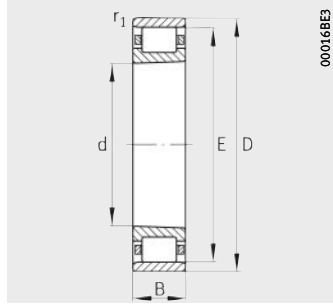
Mounting dimensions

| Mounting dimensions |              |                   |                  | Basic load ratings |                        | Limiting speeds                   |  |
|---------------------|--------------|-------------------|------------------|--------------------|------------------------|-----------------------------------|--|
| $d_a$<br>h12        | $D_a$<br>H12 | $E_{tk1}$<br>nom. | $r_{a1}$<br>max. | dyn.<br>$C_r$<br>N | stat.<br>$C_{0r}$<br>N | $n_G$ grease<br>$\text{min}^{-1}$ | $n_G$ oil <sup>3)</sup><br>$\text{min}^{-1}$ |
| 208                 | 244          | 237,8             | 1,1              | 210 000            | 340 000                | 3 400                             | 3 800  |
| 215                 | 267,8        | 258,8             | 2,1              | 370 000            | 550 000                | 3 200                             | 3 600  |
| 221                 | 261          | 254,3             | 1,5              | 255 000            | 420 000                | 3 200                             | 3 600  |
| 229                 | 284,3        | 274,5             | 2,1              | 395 000            | 600 000                | 3 000                             | 3 400  |
| 241                 | 281          | 274,3             | 1,5              | 265 000            | 450 000                | 3 000                             | 3 400  |
| 250                 | 313,5        | 302,5             | 3                | 510 000            | 770 000                | 3 000                             | 3 400  |
| 261                 | 301          | 294,3             | 1,5              | 280 000            | 490 000                | 2 800                             | 3 200  |
| 270                 | 333,5        | 322,5             | 3                | 540 000            | 840 000                | 3 000                             | 3 400  |
| 286                 | 336          | 328               | 1,5              | 420 000            | 730 000                | 2 400                             | 2 800  |
| 296                 | 368,2        | 355,5             | 4                | 650 000            | 1 010 000              | 3 000                             | 3 400  |
| 306                 | 356          | 348               | 1,5              | 445 000            | 800 000                | 2 200                             | 2 600  |
| 316                 | 388,2        | 375,5             | 4                | 680 000            | 1 100 000              | 3 000                             | 3 400  |
| 330                 | 392          | 382,5             | 3                | 600 000            | 1 020 000              | 1 900                             | 2 200  |
| 340                 | 424,6        | 410               | 4                | 900 000            | 1 430 000              | 1 800                             | 2 000  |
| 350                 | 412          | 402,5             | 3                | 620 000            | 1 090 000              | 1 800                             | 2 000  |
| 360                 | 444,6        | 430               | 4                | 910 000            | 1 490 000              | 1 700                             | 1 900  |
| 370                 | 433          | 422,5             | 3                | 650 000            | 1 200 000              | 1 700                             | 1 900  |
| 385                 | 480          | 463,8             | 5                | 1 120 000          | 1 830 000              | 1 600                             | 1 800  |
| 390                 | 453          | 442,5             | 3                | 660 000            | 1 230 000              | 1 600                             | 1 800  |
| 405                 | 500          | 483,8             | 5                | 1 150 000          | 1 910 000              | 1 500                             | 1 700  |

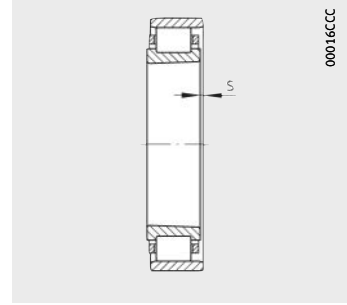


# Super precision cylindrical roller bearings

Single row  
Steel rollers



N10, N19



Axial displacement

**Dimension table** (continued) · Dimensions in mm

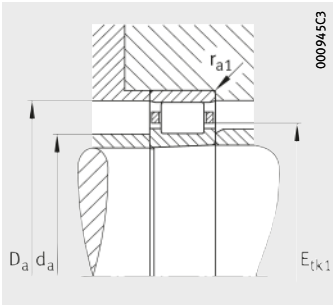
| Designation <sup>1)</sup> | Mass<br>m<br>≈ kg | Dimensions |     |     |                        |     | Axial displacement <sup>2)</sup><br>s |
|---------------------------|-------------------|------------|-----|-----|------------------------|-----|---------------------------------------|
|                           |                   | d          | D   | B   | r <sub>1</sub><br>min. | E   |                                       |
| <b>N1976-K-M1-SP</b>      | 40                | <b>380</b> | 520 | 65  | 4                      | 484 | 8,1                                   |
| <b>N1076-K-M1-SP</b>      | 66,6              | <b>380</b> | 560 | 82  | 5                      | 515 | 9,3                                   |
| <b>N1980-K-M1-SP</b>      | 41,7              | <b>400</b> | 540 | 65  | 4                      | 504 | 8,1                                   |
| <b>N1080-K-M1-SP</b>      | 88,1              | <b>400</b> | 600 | 90  | 5                      | 550 | 10,4                                  |
| <b>N1984-K-M1-SP</b>      | 43,5              | <b>420</b> | 560 | 65  | 4                      | 524 | 8,1                                   |
| <b>N1084-K-M1-SP</b>      | 90,7              | <b>420</b> | 620 | 90  | 5                      | 570 | 10,4                                  |
| <b>N1988-K-M1-SP</b>      | 60,2              | <b>440</b> | 600 | 74  | 4                      | 558 | 9,1                                   |
| <b>N1088-K-M1-SP</b>      | 106               | <b>440</b> | 650 | 94  | 6                      | 597 | 10,8                                  |
| <b>N1992-K-M1-SP</b>      | 62,6              | <b>460</b> | 620 | 74  | 4                      | 578 | 9,1                                   |
| <b>N1092-K-M1-SP</b>      | 120               | <b>460</b> | 680 | 100 | 6                      | 624 | 11,6                                  |
| <b>N1996-K-M1-SP</b>      | 73,1              | <b>480</b> | 650 | 78  | 5                      | 605 | 9,5                                   |
| <b>N1096-K-M1-SP</b>      | 125               | <b>480</b> | 700 | 100 | 6                      | 644 | 11,6                                  |
| <b>N19/500-K-M1-SP</b>    | 75                | <b>500</b> | 670 | 78  | 5                      | 625 | 9,5                                   |
| <b>N10/500-K-M1-SP</b>    | 130               | <b>500</b> | 720 | 100 | 6                      | 664 | 11,6                                  |

<sup>1)</sup> Explanation of short designations, see page 198.

The bearings are also available with a cylindrical bore (without suffix K), ordering example: N1976-M1-SP.

<sup>2)</sup> Axial displacement of outer ring from central position.

<sup>3)</sup> Minimal quantity oil lubrication.



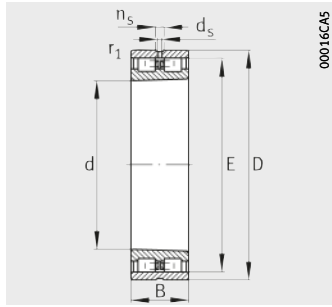
Mounting dimensions

| Mounting dimensions |              |                   |                  | Basic load ratings |                        | Limiting speeds                   |  |
|---------------------|--------------|-------------------|------------------|--------------------|------------------------|-----------------------------------|--|
| $d_a$<br>h12        | $D_a$<br>H12 | $E_{tk1}$<br>nom. | $r_{a1}$<br>max. | dyn.<br>$C_r$<br>N | stat.<br>$C_{0r}$<br>N | $n_G$ grease<br>$\text{min}^{-1}$ | $n_G$ oil <sup>3)</sup><br>$\text{min}^{-1}$ |
| 416                 | 487          | 475,5             | 4                | 810 000            | 1 500 000              | 1 500                             | 1 700  |
| 425                 | 520          | 503,8             | 5                | 1 170 000          | 1 990 000              | 1 400                             | 1 600  |
| 436                 | 507          | 495,5             | 4                | 810 000            | 1 510 000              | 1 500                             | 1 700  |
| 450                 | 555,4        | 537,5             | 5                | 1 380 000          | 2 330 000              | 1 300                             | 1 500  |
| 456                 | 527          | 515,5             | 4                | 830 000            | 1 600 000              | 1 400                             | 1 600  |
| 470                 | 575,4        | 557,5             | 5                | 1 410 000          | 2 430 000              | 1 300                             | 1 500  |
| 482                 | 562          | 548,5             | 4                | 1 020 000          | 1 960 000              | 1 300                             | 1 500  |
| 493                 | 602,6        | 584               | 6                | 1 560 000          | 2 750 000              | 1 200                             | 1 400  |
| 502                 | 582          | 568,5             | 4                | 1 020 000          | 1 970 000              | 1 300                             | 1 500  |
| 516                 | 630,2        | 610,5             | 6                | 1 680 000          | 2 950 000              | 1 100                             | 1 300  |
| 525                 | 609          | 595               | 5                | 1 150 000          | 2 250 000              | 1 200                             | 1 400  |
| 536                 | 650,2        | 630,5             | 6                | 1 720 000          | 3 100 000              | 1 100                             | 1 300  |
| 545                 | 629          | 615               | 5                | 1 160 000          | 2 310 000              | 1 200                             | 1 400  |
| 556                 | 670,2        | 650,5             | 6                | 1 750 000          | 3 200 000              | 1 000                             | 1 200  |

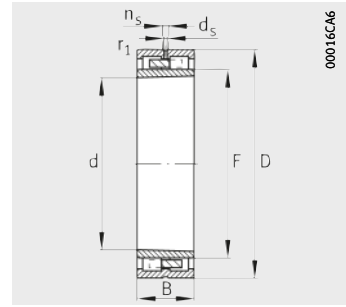


# Super precision cylindrical roller bearings

Double row



NN30



NNU49

**Dimension table** - Dimensions in mm

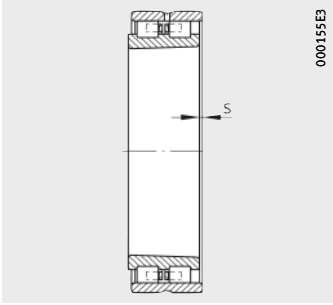
| Designation <sup>1)</sup> | Mass<br>m<br>≈ kg | Dimensions |     |    |               |      |   |       |       |
|---------------------------|-------------------|------------|-----|----|---------------|------|---|-------|-------|
|                           |                   | d          | D   | B  | $r_1$<br>min. | E    | F | $n_s$ | $d_s$ |
| NN3006-AS-K-M-SP          | 0,19              | 30         | 55  | 19 | 1             | 48,5 | – | 4,8   | 3,2   |
| NN3006-D-K-TVP-SP-XL      | 0,18              | 30         | 55  | 19 | 1             | 48,5 | – | –     | –     |
| NN3007-AS-K-M-SP          | 0,25              | 35         | 62  | 20 | 1             | 55   | – | 4,8   | 3,2   |
| NN3007-D-K-TVP-SP-XL      | 0,24              | 35         | 62  | 20 | 1             | 55   | – | –     | –     |
| NN3008-AS-K-M-SP          | 0,3               | 40         | 68  | 21 | 1             | 61   | – | 4,8   | 3,2   |
| NN3008-D-K-TVP-SP-XL      | 0,28              | 40         | 68  | 21 | 1             | 61   | – | –     | –     |
| NN3009-AS-K-M-SP          | 0,39              | 45         | 75  | 23 | 1             | 67,5 | – | 4,8   | 3,2   |
| NN3009-D-K-TVP-SP-XL      | 0,36              | 45         | 75  | 23 | 1             | 67,5 | – | –     | –     |
| NN3010-AS-K-M-SP          | 0,43              | 50         | 80  | 23 | 1             | 72,5 | – | 4,8   | 3,2   |
| NN3010-D-K-TVP-SP-XL      | 0,39              | 50         | 80  | 23 | 1             | 72,5 | – | –     | –     |
| NN3011-AS-K-M-SP          | 0,63              | 55         | 90  | 26 | 1,1           | 81   | – | 4,8   | 3,2   |
| NN3011-D-K-TVP-SP-XL      | 0,59              | 55         | 90  | 26 | 1,1           | 81   | – | –     | –     |
| NN3012-AS-K-M-SP          | 0,67              | 60         | 95  | 26 | 1,1           | 86,1 | – | 4,8   | 3,2   |
| NN3012-D-K-TVP-SP-XL      | 0,63              | 60         | 95  | 26 | 1,1           | 86,1 | – | –     | –     |
| NN3013-AS-K-M-SP          | 0,71              | 65         | 100 | 26 | 1,1           | 91   | – | 4,8   | 3,2   |
| NN3013-D-K-TVP-SP-XL      | 0,67              | 65         | 100 | 26 | 1,1           | 91   | – | –     | –     |
| NN3014-AS-K-M-SP          | 1,04              | 70         | 110 | 30 | 1,1           | 100  | – | 6,5   | 3,2   |
| NN3014-D-K-TVP-SP-XL      | 0,98              | 70         | 110 | 30 | 1,1           | 100  | – | –     | –     |
| NN3015-AS-K-M-SP          | 1,09              | 75         | 115 | 30 | 1,1           | 105  | – | 6,5   | 3,2   |
| NN3015-D-K-TVP-SP-XL      | 1,02              | 75         | 115 | 30 | 1,1           | 105  | – | –     | –     |
| NN3016-AS-K-M-SP          | 1,51              | 80         | 125 | 34 | 1,1           | 113  | – | 6,5   | 3,2   |
| NN3016-D-K-TVP-SP-XL      | 1,42              | 80         | 125 | 34 | 1,1           | 113  | – | –     | –     |
| NN3017-AS-K-M-SP          | 1,58              | 85         | 130 | 34 | 1,1           | 118  | – | 6,5   | 3,2   |
| NN3017-D-K-TVP-SP-XL      | 1,48              | 85         | 130 | 34 | 1,1           | 118  | – | –     | –     |
| NN3018-AS-K-M-SP          | 2,05              | 90         | 140 | 37 | 1,5           | 127  | – | 6,5   | 3,2   |
| NN3018-D-K-TVP-SP-XL      | 1,93              | 90         | 140 | 37 | 1,5           | 127  | – | –     | –     |
| NN3019-AS-K-M-SP          | 2,14              | 95         | 145 | 37 | 1,5           | 132  | – | 6,5   | 3,2   |
| NN3019-D-K-TVP-SP-XL      | 2,03              | 95         | 145 | 37 | 1,5           | 132  | – | –     | –     |

<sup>1)</sup> Explanation of short designations, see page 198.

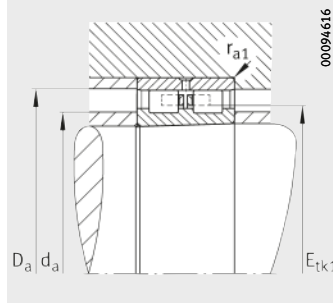
The bearings are also available with a cylindrical bore (without suffix K), ordering example: NN3006-D-TVP-SP-XL.

<sup>2)</sup> Axial displacement of outer ring from central position.

<sup>3)</sup> Minimal quantity oil lubrication.



Axial displacement



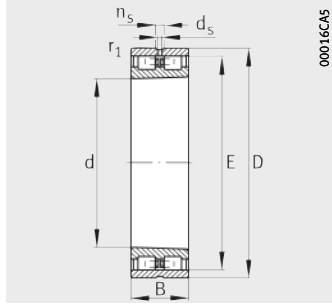
Mounting dimensions

| Axial displacement <sup>2)</sup><br>s | Mounting dimensions   |                       |                         | Basic load ratings          |                               | Limiting speeds                            |   |
|---------------------------------------|-----------------------|-----------------------|-------------------------|-----------------------------|-------------------------------|--|---|
|                                       | d <sub>a</sub><br>h12 | D <sub>a</sub><br>H12 | r <sub>a1</sub><br>max. | dyn.<br>C <sub>r</sub><br>N | stat.<br>C <sub>0r</sub><br>N | n <sub>G</sub> grease<br>min <sup>-1</sup> | n <sub>G</sub> oil <sup>3)</sup><br>min <sup>-1</sup> |
| 1,4                                   | 37,5                  | 50                    | 1                       | 29 000                      | 34 000                        | 16 000                                     | 19 000  |
| 1,7                                   | 38,5                  | 50                    | 1                       | 30 000                      | 31 000                        | 20 000                                     | 24 000  |
| 1,4                                   | 43                    | 57                    | 1                       | 35 500                      | 44 000                        | 14 000                                     | 17 000  |
| 1,4                                   | 43                    | 56,5                  | 1                       | 40 500                      | 41 500                        | 17 000                                     | 21 000  |
| 1,4                                   | 48                    | 63                    | 1                       | 45 000                      | 58 000                        | 12 000                                     | 15 000  |
| 1,7                                   | 49                    | 62,6                  | 1                       | 46 500                      | 52 000                        | 16 000                                     | 19 000  |
| 1,7                                   | 53,5                  | 69                    | 1                       | 54 000                      | 72 000                        | 11 000                                     | 14 000  |
| 1,7                                   | 53,5                  | 69,2                  | 1                       | 59 000                      | 65 000                        | 14 000                                     | 17 000  |
| 1,7                                   | 58,5                  | 74                    | 1                       | 57 000                      | 79 000                        | 10 000                                     | 13 000  |
| 1,7                                   | 58,5                  | 74,2                  | 1                       | 63 000                      | 73 000                        | 13 000                                     | 16 000  |
| 1,9                                   | 65                    | 83                    | 1                       | 72 000                      | 101 000                       | 9 000                                      | 11 000  |
| 1,9                                   | 65                    | 82,9                  | 1                       | 82 000                      | 97 000                        | 12 000                                     | 14 000  |
| 1,9                                   | 70,1                  | 88                    | 1                       | 76 000                      | 111 000                       | 8 500                                      | 10 000  |
| 1,9                                   | 70,1                  | 88                    | 1                       | 87 000                      | 106 000                       | 11 000                                     | 13 000  |
| 1,9                                   | 75                    | 93                    | 1                       | 77 000                      | 116 000                       | 8 000                                      | 9 500   |
| 1,9                                   | 75                    | 92,9                  | 1                       | 91 000                      | 116 000                       | 10 000                                     | 12 000  |
| 2,3                                   | 82                    | 102                   | 1                       | 98 000                      | 148 000                       | 7 000                                      | 8 500   |
| 2,3                                   | 82                    | 102,3                 | 1                       | 113 000                     | 145 000                       | 9 500                                      | 11 000  |
| 2,3                                   | 87                    | 107                   | 1                       | 99 000                      | 155 000                       | 6 700                                      | 8 000   |
| 2,3                                   | 87                    | 107,3                 | 1                       | 112 000                     | 146 000                       | 9 000                                      | 11 000  |
| 2,5                                   | 93                    | 116                   | 1                       | 119 000                     | 186 000                       | 6 300                                      | 7 500   |
| 2,5                                   | 93                    | 115,6                 | 1                       | 139 000                     | 182 000                       | 8 500                                      | 10 000  |
| 2,5                                   | 98                    | 121                   | 1                       | 125 000                     | 201 000                       | 6 000                                      | 7 000   |
| 2,5                                   | 98                    | 120,6                 | 1                       | 138 000                     | 183 000                       | 8 000                                      | 9 500   |
| 2,6                                   | 105                   | 130                   | 1,5                     | 141 000                     | 225 000                       | 5 600                                      | 6 700   |
| 2,5                                   | 105                   | 129,8                 | 1,5                     | 162 000                     | 216 000                       | 7 500                                      | 9 000   |
| 2,6                                   | 110                   | 135                   | 1,5                     | 144 000                     | 234 000                       | 5 300                                      | 6 300   |
| 2,5                                   | 110                   | 134,8                 | 1,5                     | 170 000                     | 234 000                       | 7 000                                      | 8 500   |

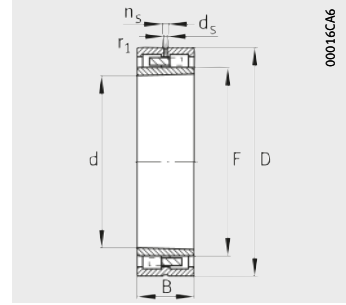


# Super precision cylindrical roller bearings

Double row



NN30



NNU49

Dimension table (continued) · Dimensions in mm

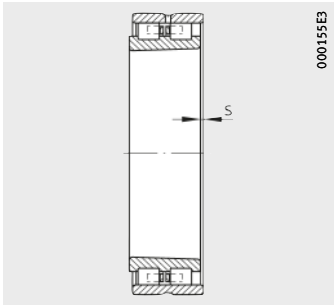
| Designation <sup>1)</sup> | Mass<br>m<br>≈ kg | Dimensions |     |    |                        |     |       |                |                |
|---------------------------|-------------------|------------|-----|----|------------------------|-----|-------|----------------|----------------|
|                           |                   | d          | D   | B  | r <sub>1</sub><br>min. | E   | F     | n <sub>s</sub> | d <sub>s</sub> |
| NNU4920-S-K-M-SP          | 1,88              | 100        | 140 | 40 | 1,1                    | –   | 113   | 6,5            | 3,2            |
| NN3020-AS-K-M-SP          | 2,23              | 100        | 150 | 37 | 1,5                    | 137 | –     | 6,5            | 3,2            |
| NN3020-D-K-TVP-SP-XL      | 2,09              | 100        | 150 | 37 | 1,5                    | 137 | –     | –              | –              |
| NNU4921-S-K-M-SP          | 1,93              | 105        | 145 | 40 | 1,1                    | –   | 118   | 6,5            | 3,2            |
| NN3021-AS-K-M-SP          | 2,84              | 105        | 160 | 41 | 2                      | 146 | –     | 6,5            | 3,2            |
| NN3021-D-K-TVP-SP-XL      | 2,68              | 105        | 160 | 41 | 2                      | 146 | –     | –              | –              |
| NNU4922-S-K-M-SP          | 2,01              | 110        | 150 | 40 | 1,1                    | –   | 123   | 6,5            | 3,2            |
| NN3022-AS-K-M-SP          | 3,61              | 110        | 170 | 45 | 2                      | 155 | –     | 6,5            | 3,2            |
| NN3022-D-K-TVP-SP-XL      | 3,41              | 110        | 170 | 45 | 2                      | 155 | –     | –              | –              |
| NNU4924-S-K-M-SP          | 2,78              | 120        | 165 | 45 | 1,1                    | –   | 134,5 | 6,5            | 3,2            |
| NN3024-AS-K-M-SP          | 3,94              | 120        | 180 | 46 | 2                      | 165 | –     | 6,5            | 3,2            |
| NN3024-D-K-TVP-SP-XL      | 3,72              | 120        | 180 | 46 | 2                      | 165 | –     | –              | –              |
| NNU4926-S-K-M-SP          | 3,81              | 130        | 180 | 50 | 1,5                    | –   | 146   | 6,5            | 3,2            |
| NN3026-AS-K-M-SP          | 5,78              | 130        | 200 | 52 | 2                      | 182 | –     | 9,5            | 4,8            |
| NNU4928-S-K-M-SP          | 4,04              | 140        | 190 | 50 | 1,5                    | –   | 156   | 6,5            | 3,2            |
| NN3028-AS-K-M-SP          | 6,22              | 140        | 210 | 53 | 2                      | 192 | –     | 9,5            | 4,8            |
| NNU4930-S-K-M-SP          | 6,1               | 150        | 210 | 60 | 2                      | –   | 168,5 | 6,5            | 3,2            |
| NN3030-AS-K-M-SP          | 7,59              | 150        | 225 | 56 | 2,1                    | 206 | –     | 9,5            | 4,8            |
| NNU4932-S-K-M-SP          | 6,46              | 160        | 220 | 60 | 2                      | –   | 178,5 | 6,5            | 3,2            |
| NN3032-AS-K-M-SP          | 9,23              | 160        | 240 | 60 | 2,1                    | 219 | –     | 9,5            | 4,8            |
| NNU4934-S-K-M-SP          | 6,9               | 170        | 230 | 60 | 2                      | –   | 188,5 | 6,5            | 3,2            |
| NN3034-AS-K-M-SP          | 12,5              | 170        | 260 | 67 | 2,1                    | 236 | –     | 9,5            | 4,8            |
| NNU4936-S-K-M-SP          | 9,96              | 180        | 250 | 69 | 2                      | –   | 202   | 9,5            | 4,8            |
| NN3036-AS-K-M-SP          | 16,4              | 180        | 280 | 74 | 2,1                    | 255 | –     | 12,2           | 6,3            |
| NNU4938-S-K-M-SP          | 10,6              | 190        | 260 | 69 | 2                      | –   | 212   | 9,5            | 4,8            |
| NN3038-AS-K-M-SP          | 17,3              | 190        | 290 | 75 | 2,1                    | 265 | –     | 12,2           | 6,3            |
| NNU4940-S-K-M-SP          | 14,7              | 200        | 280 | 80 | 2,1                    | –   | 225   | 12,2           | 6,3            |
| NN3040-AS-K-M-SP          | 22,2              | 200        | 310 | 82 | 2,1                    | 282 | –     | 12,2           | 6,3            |
| NNU4944-S-K-M-SP          | 16,3              | 220        | 300 | 80 | 2,1                    | –   | 245   | 12,2           | 6,3            |
| NN3044-AS-K-M-SP          | 29,1              | 220        | 340 | 90 | 3                      | 310 | –     | 15             | 8              |

<sup>1)</sup> Explanation of short designations, see page 198.

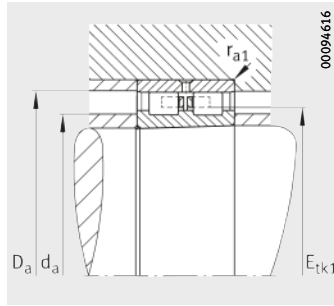
The bearings are also available with a cylindrical bore (without suffix K), ordering example: NN3020-D-TVP-SP-XL.

<sup>2)</sup> Axial displacement of outer ring from central position.

<sup>3)</sup> Minimal quantity oil lubrication.



Axial displacement



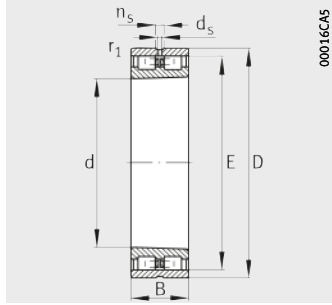
Mounting dimensions

| Axial displacement <sup>2)</sup><br>s | Mounting dimensions   |                       |                         | Basic load ratings          |                               | Limiting speeds                            |   |
|---------------------------------------|-----------------------|-----------------------|-------------------------|-----------------------------|-------------------------------|--|---|
|                                       | d <sub>a</sub><br>h12 | D <sub>a</sub><br>H12 | r <sub>a1</sub><br>max. | dyn.<br>C <sub>r</sub><br>N | stat.<br>C <sub>0r</sub><br>N | n <sub>G</sub> grease<br>min <sup>-1</sup> | n <sub>G</sub> oil <sup>3)</sup><br>min <sup>-1</sup> |
| 2                                     | 112                   | 129                   | 1,1                     | 128 000                     | 255 000                       | 5 300                                      | 6 300   |
| 2,6                                   | 115                   | 140                   | 1,5                     | 147 000                     | 243 000                       | 5 300                                      | 6 300   |
| 2,5                                   | 115                   | 139,8                 | 1,5                     | 169 000                     | 235 000                       | 7 000                                      | 8 000   |
| 2                                     | 117                   | 134                   | 1,1                     | 130 000                     | 260 000                       | 5 300                                      | 6 300   |
| 2,6                                   | 120                   | 149                   | 2                       | 192 000                     | 310 000                       | 4 800                                      | 5 600   |
| 2,6                                   | 120                   | 149                   | 2                       | 226 000                     | 310 000                       | 6 300                                      | 7 500   |
| 2                                     | 122                   | 139                   | 1,1                     | 132 000                     | 270 000                       | 5 000                                      | 6 000   |
| 2,9                                   | 127                   | 158                   | 2                       | 220 000                     | 360 000                       | 4 500                                      | 5 300   |
| 2,9                                   | 127                   | 158,3                 | 2                       | 260 000                     | 360 000                       | 6 000                                      | 7 000   |
| 2,3                                   | 133,4                 | 154,5                 | 1,1                     | 175 000                     | 340 000                       | 4 500                                      | 5 300   |
| 3,1                                   | 137                   | 168                   | 2                       | 232 000                     | 390 000                       | 4 300                                      | 5 000   |
| 3,1                                   | 137                   | 168,4                 | 2                       | 275 000                     | 390 000                       | 5 600                                      | 6 700   |
| 2,7                                   | 144,7                 | 166                   | 1,5                     | 188 000                     | 385 000                       | 4 000                                      | 4 800   |
| 3,1                                   | 150                   | 186                   | 2                       | 295 000                     | 500 000                       | 3 800                                      | 4 500   |
| 2,7                                   | 155,1                 | 176                   | 1,5                     | 190 000                     | 400 000                       | 3 800                                      | 4 500   |
| 3,4                                   | 160                   | 196                   | 2                       | 300 000                     | 520 000                       | 3 600                                      | 4 300   |
| 2,7                                   | 167,2                 | 196,5                 | 2                       | 330 000                     | 650 000                       | 3 600                                      | 4 300   |
| 3,8                                   | 172                   | 210                   | 2,1                     | 335 000                     | 590 000                       | 3 400                                      | 4 000   |
| 2,7                                   | 177,2                 | 206,5                 | 2                       | 335 000                     | 680 000                       | 3 400                                      | 4 000   |
| 4,3                                   | 183                   | 224                   | 2,1                     | 375 000                     | 670 000                       | 3 200                                      | 3 800   |
| 2,7                                   | 187,2                 | 216,5                 | 2                       | 340 000                     | 700 000                       | 3 200                                      | 3 800   |
| 4,6                                   | 196                   | 241                   | 2,1                     | 450 000                     | 800 000                       | 3 000                                      | 3 600   |
| 3,2                                   | 200,5                 | 232                   | 2                       | 405 000                     | 860 000                       | 3 000                                      | 3 600   |
| 4,8                                   | 209                   | 260                   | 2,1                     | 570 000                     | 1 000 000                     | 2 800                                      | 3 400   |
| 3,2                                   | 210,5                 | 242                   | 2                       | 410 000                     | 880 000                       | 2 800                                      | 3 400   |
| 4,8                                   | 219                   | 271                   | 2,1                     | 580 000                     | 1 040 000                     | 2 600                                      | 3 200   |
| 4,3                                   | 223                   | 259                   | 2,1                     | 490 000                     | 1 040 000                     | 2 600                                      | 3 200   |
| 5,7                                   | 232                   | 288                   | 2,1                     | 660 000                     | 1 190 000                     | 2 400                                      | 3 000   |
| 4,3                                   | 243                   | 279                   | 2,1                     | 510 000                     | 1 140 000                     | 2 400                                      | 3 000   |
| 5,7                                   | 254                   | 317                   | 2,5                     | 810 000                     | 1 450 000                     | 2 200                                      | 2 800   |

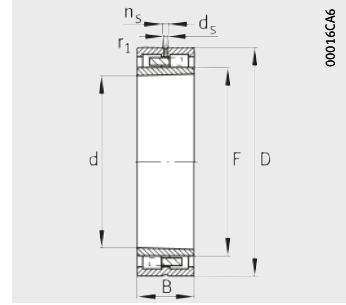


# Super precision cylindrical roller bearings

Double row



NN30



NNU49

Dimension table (continued) · Dimensions in mm

| Designation <sup>1)</sup> | Mass<br>m<br>≈ kg | Dimensions |     |     |                        |     |     |                |                |
|---------------------------|-------------------|------------|-----|-----|------------------------|-----|-----|----------------|----------------|
|                           |                   | d          | D   | B   | r <sub>1</sub><br>min. | E   | F   | n <sub>s</sub> | d <sub>s</sub> |
| NNU4948-S-K-M-SP          | 17,1              | 240        | 320 | 80  | 2,1                    | –   | 265 | 12,2           | 6,3            |
| NN3048-AS-K-M-SP          | 31,5              | 240        | 360 | 92  | 3                      | 330 | –   | 15             | 8              |
| NNU4952-S-K-M-SP          | 30,4              | 260        | 360 | 100 | 2,1                    | –   | 292 | 15             | 8              |
| NN3052-AS-K-M-SP          | 46,2              | 260        | 400 | 104 | 4                      | 364 | –   | 15             | 8              |
| NNU4956-S-K-M-SP          | 32,5              | 280        | 380 | 100 | 2,1                    | –   | 312 | 15             | 8              |
| NN3056-AS-K-M-SP          | 49,7              | 280        | 420 | 106 | 4                      | 384 | –   | 15             | 8              |
| NNU4960-S-K-M-SP          | 48,6              | 300        | 420 | 118 | 4                      | –   | 339 | 17,7           | 9,5            |
| NN3060-AS-K-M-SP          | 68,5              | 300        | 460 | 118 | 4                      | 418 | –   | 17,7           | 9,5            |
| NNU4964-S-K-M-SP          | 52,5              | 320        | 440 | 118 | 3                      | –   | 359 | 17,7           | 9,5            |
| NN3064-AS-K-M-SP          | 73,8              | 320        | 480 | 121 | 4                      | 438 | –   | 17,7           | 9,5            |
| NNU4968-S-K-M-SP          | 55,7              | 340        | 460 | 118 | 3                      | –   | 379 | 17,7           | 9,5            |
| NN3068-AS-K-M-SP          | 99,3              | 340        | 520 | 133 | 5                      | 473 | –   | 17,7           | 9,5            |
| NNU4972-S-K-M-SP          | 57,3              | 360        | 480 | 118 | 3                      | –   | 399 | 17,7           | 9,5            |
| NN3072-AS-K-M-SP          | 104               | 360        | 540 | 134 | 5                      | 493 | –   | 17,7           | 9,5            |
| NNU4976-S-K-M-SP          | 86,9              | 380        | 520 | 140 | 4                      | –   | 426 | 17,7           | 9,5            |
| NN3076-AS-K-M-SP          | 110               | 380        | 560 | 135 | 5                      | 513 | –   | 17,7           | 9,5            |
| NNU4980-S-K-M-SP          | 91                | 400        | 540 | 140 | 4                      | –   | 446 | 17,7           | 9,5            |
| NN3080-AS-K-M-SP          | 143               | 400        | 600 | 148 | 5                      | 549 | –   | 17,7           | 9,5            |
| NNU4984-S-K-M-SP          | 94,4              | 420        | 560 | 140 | 4                      | –   | 466 | 17,7           | 9,5            |
| NN3084-AS-K-M-SP          | 150               | 420        | 620 | 150 | 5                      | 569 | –   | 17,7           | 9,5            |
| NNU4988-S-K-M-SP          | 130,4             | 440        | 600 | 160 | 4                      | –   | 490 | 17,7           | 9,5            |
| NN3088-AS-K-M-SP          | 172               | 440        | 650 | 157 | 6                      | 597 | –   | 23,5           | 12,5           |
| NNU4992-S-K-M-SP          | 134               | 460        | 620 | 160 | 4                      | –   | 510 | 17,7           | 9,5            |
| NN3092-AS-K-M-SP          | 197               | 460        | 680 | 163 | 6                      | 624 | –   | 23,5           | 12,5           |
| NNU4996-S-K-M-SP          | 158               | 480        | 650 | 170 | 5                      | –   | 534 | 17,7           | 9,5            |
| NN3096-AS-K-M-SP          | 208               | 480        | 700 | 165 | 6                      | 644 | –   | 23,5           | 12,5           |
| NNU49/500-S-K-M-SP        | 163               | 500        | 670 | 170 | 5                      | –   | 554 | 17,7           | 9,5            |
| NN30/500-AS-K-M-SP        | 214               | 500        | 720 | 167 | 6                      | 664 | –   | 23,5           | 12,5           |

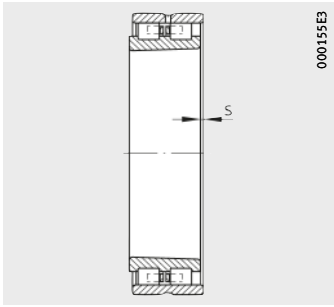
<sup>1)</sup> Explanation of short designations, see page 198.

The bearings are also available with a cylindrical bore (without suffix K), ordering example: NN3006-D-TVP-SP-XL.

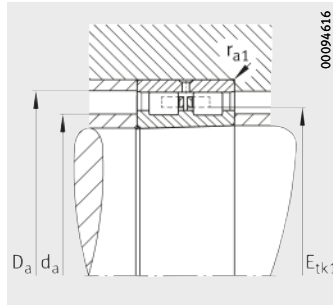
<sup>2)</sup> Axial displacement of outer ring from central position.

<sup>3)</sup> Minimal quantity oil lubrication.





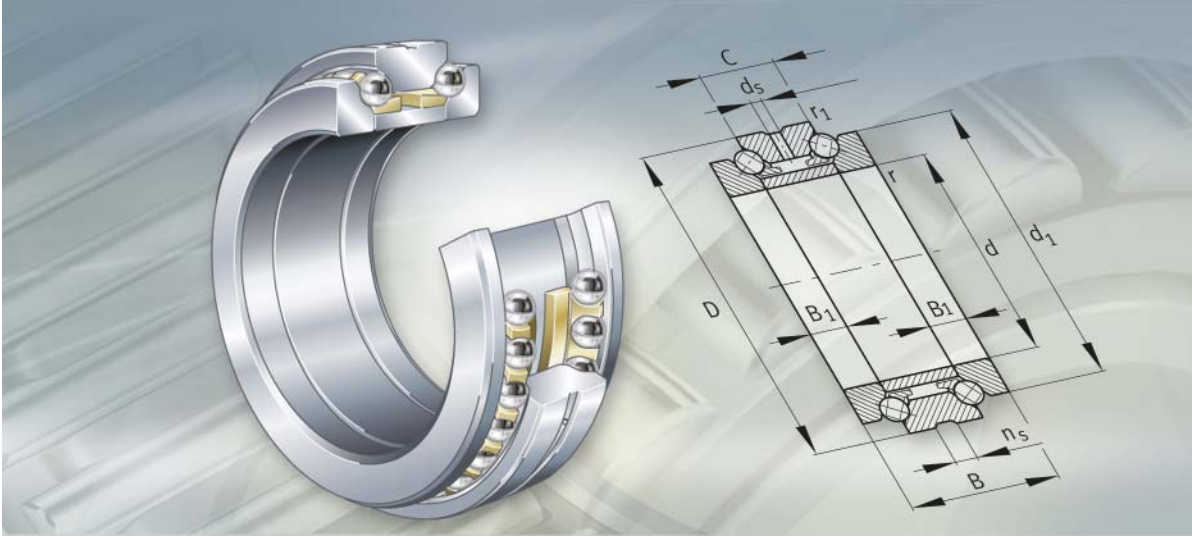
Axial displacement



Mounting dimensions

| Axial displacement <sup>2)</sup><br>s | Mounting dimensions   |                       |                         | Basic load ratings          |                               | Limiting speeds                            |   |
|---------------------------------------|-----------------------|-----------------------|-------------------------|-----------------------------|-------------------------------|--|---|
|                                       | d <sub>a</sub><br>h12 | D <sub>a</sub><br>H12 | r <sub>a1</sub><br>max. | dyn.<br>C <sub>r</sub><br>N | stat.<br>C <sub>0r</sub><br>N | n <sub>G</sub> grease<br>min <sup>-1</sup> | n <sub>G</sub> oil <sup>3)</sup><br>min <sup>-1</sup> |
| 4,3                                   | 263                   | 299                   | 2,1                     | 530 000                     | 1 210 000                     | 2 200                                      | 2 800   |
| 6,1                                   | 274                   | 337                   | 2,5                     | 840 000                     | 1 580 000                     | 2 000                                      | 2 600   |
| 5,4                                   | 289,4                 | 334                   | 2,1                     | 750 000                     | 1 690 000                     | 2 000                                      | 2 600   |
| 6,6                                   | 300                   | 372                   | 3                       | 1 070 000                   | 2 010 000                     | 1 900                                      | 2 400   |
| 5,4                                   | 309,4                 | 354                   | 2,1                     | 770 000                     | 1 790 000                     | 1 900                                      | 2 400   |
| 6,9                                   | 320                   | 392                   | 3                       | 1 090 000                   | 2 090 000                     | 1 800                                      | 2 200   |
| 6,3                                   | 336                   | 389                   | 3                       | 1 040 000                   | 2 380 000                     | 1 700                                      | 2 000   |
| 7,5                                   | 346                   | 427                   | 3                       | 1 270 000                   | 2 400 000                     | 1 600                                      | 1 900   |
| 6,3                                   | 356                   | 409                   | 3                       | 1 070 000                   | 2 550 000                     | 1 600                                      | 1 900   |
| 8                                     | 366                   | 447                   | 3                       | 1 330 000                   | 2 600 000                     | 1 600                                      | 1 900   |
| 6,3                                   | 376                   | 429                   | 3                       | 1 100 000                   | 2 650 000                     | 1 500                                      | 1 800   |
| 8,8                                   | 393                   | 483                   | 4                       | 1 640 000                   | 3 250 000                     | 1 400                                      | 1 700   |
| 6,3                                   | 396                   | 449                   | 3                       | 1 130 000                   | 2 800 000                     | 1 500                                      | 1 800   |
| 8,8                                   | 413                   | 503                   | 4                       | 1 670 000                   | 3 350 000                     | 1 400                                      | 1 700   |
| 7,2                                   | 422,6                 | 482                   | 4                       | 1 440 000                   | 3 600 000                     | 1 400                                      | 1 700   |
| 9,1                                   | 433                   | 523                   | 4                       | 1 700 000                   | 3 500 000                     | 1 300                                      | 1 600   |
| 7,2                                   | 442,6                 | 502                   | 4                       | 1 490 000                   | 3 800 000                     | 1 300                                      | 1 600   |
| 9,5                                   | 459                   | 560                   | 4                       | 2 150 000                   | 4 450 000                     | 1 200                                      | 1 500   |
| 7,2                                   | 462,6                 | 522                   | 4                       | 1 530 000                   | 4 000 000                     | 1 300                                      | 1 600   |
| 10                                    | 479                   | 580                   | 4                       | 2 140 000                   | 4 450 000                     | 1 200                                      | 1 500   |
| 6,8                                   | 486,8                 | 558                   | 4                       | 2 040 000                   | 5 200 000                     | 1 200                                      | 1 500   |
| 10,2                                  | 501                   | 609                   | 5                       | 2 430 000                   | 5 100 000                     | 1 100                                      | 1 400   |
| 6,8                                   | 506,8                 | 578                   | 4                       | 2 110 000                   | 5 500 000                     | 1 100                                      | 1 400   |
| 10,9                                  | 524                   | 636                   | 5                       | 2 600 000                   | 5 400 000                     | 1 100                                      | 1 400   |
| 7,2                                   | 530,6                 | 606                   | 5                       | 2 350 000                   | 6 100 000                     | 1 100                                      | 1 400   |
| 11,2                                  | 544                   | 656                   | 5                       | 2 700 000                   | 5 800 000                     | 1 000                                      | 1 300   |
| 7,2                                   | 550,6                 | 626                   | 5                       | 2 330 000                   | 6 100 000                     | 1 000                                      | 1 300   |
| 11,7                                  | 564                   | 677                   | 5                       | 2 700 000                   | 5 800 000                     | 1 000                                      | 1 300   |





# Axial angular contact ball bearings

Axial bearings, double direction 2344

Axial bearings BAX

# Axial angular contact ball bearings

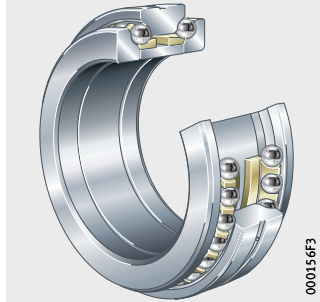
|                         | Page  |
|-------------------------|---|
| <b>Product overview</b> | Axial angular contact ball bearings ..... 222                   |
| <b>Features</b>         | Designs ..... 223   |
|                         | Sealing ..... 225   |
|                         | Lubrication ..... 225   |
|                         | Cages ..... 225   |
|                         | Bearing designations ..... 226                                  |
|                         | Marking of bearings ..... 227                                   |
| <b>Dimension tables</b> | Axial angular contact ball bearings, double direction ..... 228 |
|                         | Axial bearings BAX ..... 230                                    |



# Product overview Axial angular contact ball bearings

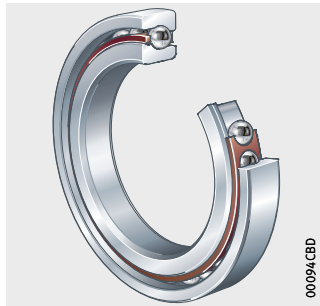
## Double direction

2344



## Axial bearings BAX

BAX



# Axial angular contact ball bearings

## Features

### Axial bearings 2344

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 mounted 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.

### Axial bearings BAX

The bearing arrangement of main spindles in machine tools are subjected to high demands. They must have high load carrying capacity and must at the same time also be suitable for high spindle speeds. Increased load carrying capacity normally brings with it a reduction in the maximum speed. Through the use of the new axial bearings BAX, it is now possible to unify both requirements.

The axial bearings:

- can support high axial loads
- have the speed capacity of main spindle bearings
- have high rigidity
- can support axial loads only.

The axial bearings BAX conform to the accuracy class P4S and are in principle supplied as ready-to-fit sets in the arrangement DB.

Axial bearings BAX correspond in their dimensions to bearings of size 70. They are thus matched to the diameters of cylindrical roller bearings N10 and 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.

Axial bearings BAX are available with a contact angle of 30° and, for even higher rigidities, also with a contact angle of 40°.



## Designs

### Axial bearings 2344, double direction

This series 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 design 2344 is available by agreement in the accuracy class UP.

### Axial bearings BAX

The axial bearings BAX are available in two preload classes, L (light) and M (medium).

Axial bearings BAX are available in two contact angle variants:

- contact angle 30° (suffix F)
- contact angle 40° (suffix H).

# Axial angular contact ball bearings

## Design of bearing arrangements

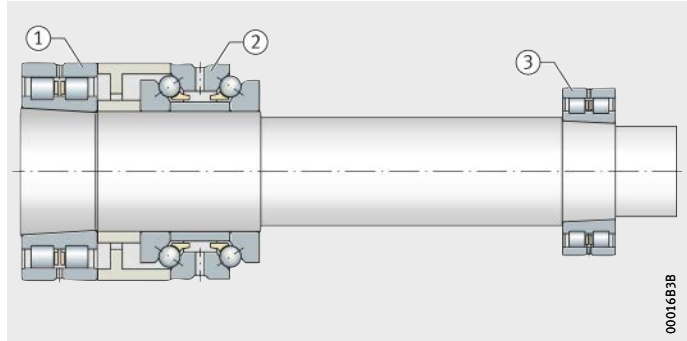
Bearing combination and arrangement:

- one double direction axial angular contact bearing and two double row cylindrical roller bearings, *Figure 6*
- two axial bearings and two double row cylindrical roller bearings, *Figure 7*.

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

*Figure 1*

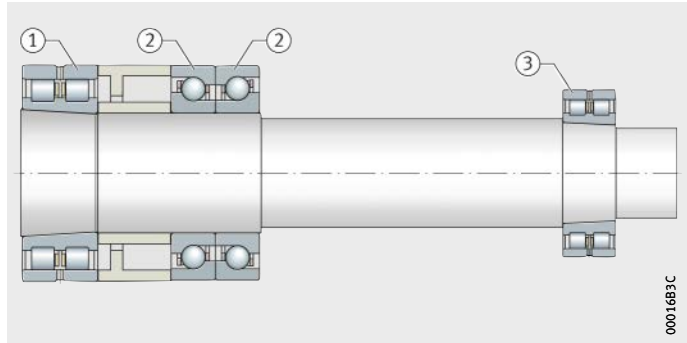
Bearing arrangement with axial angular contact ball bearing 2344



- ① Cylindrical roller bearing NN30
- ② Axial bearing BAX
- ③ Cylindrical roller bearing NN30

*Figure 2*

Bearing arrangement with axial bearings BAX



**Sealing** Axial angular contact ball bearings of the designs 2344 and BAX are available without seals.

**Lubrication** The bearings can be lubricated with oil or grease.

**Axial bearings 2344** 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.

### Cages

**Axial bearings 2344** Each row of rolling elements has a ball-guided solid brass cage. The cage is indicated by the suffix M.

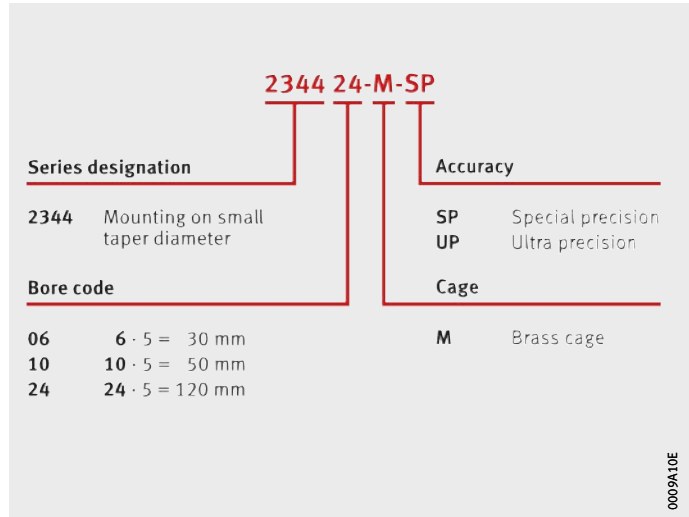
**Axial bearings BAX** The bearings are designed with a cage made from laminated fabric (suffix T).



# Axial angular contact ball bearings

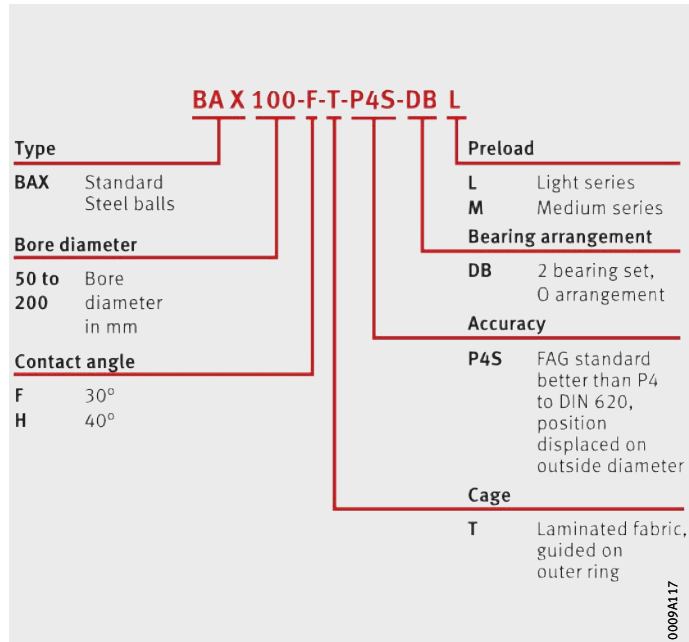
## Bearing designations

The diagram shows the structure of the short designation for axial bearings of the design 2344, *Figure 3*.



*Figure 3*  
Bearing designation of axial bearings 2344

The structure for axial bearings BAX is shown in *Figure 4*.

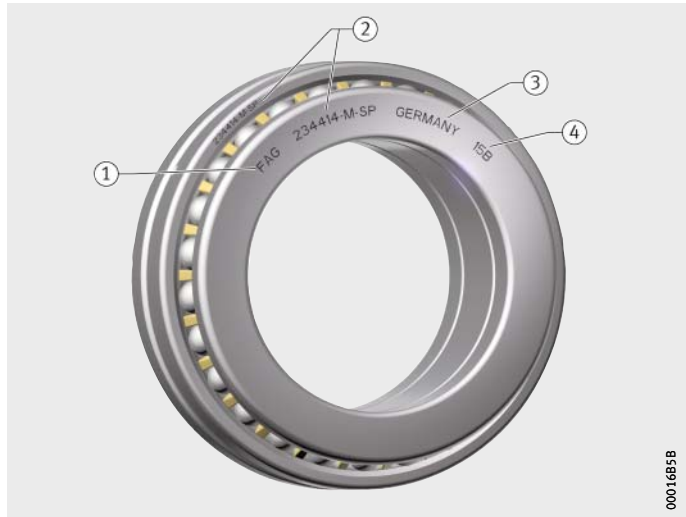


*Figure 4*  
Bearing designation of axial bearings BAX



## Marking of bearings

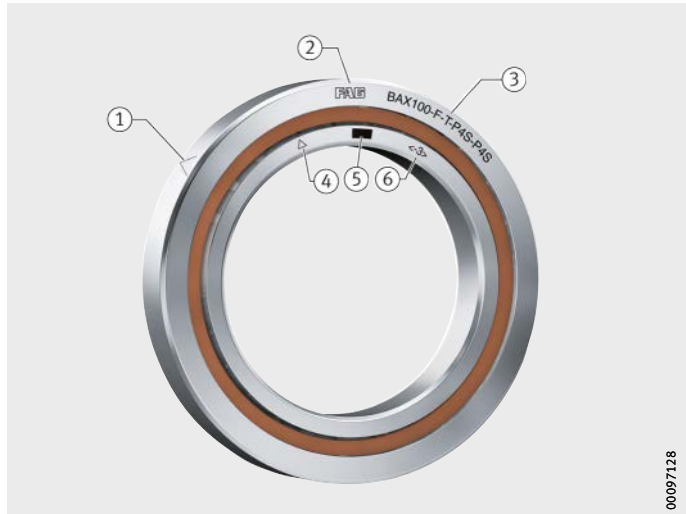
Marking of the bearings on the end faces of the bearing rings is shown in *Figure 5*.



- ① Trademark
- ② Short designation (bearing designation)
- ③ Country of manufacture
- ④ Internal code

*Figure 5*  
Marking of bearings

The marking on the end face of the axial bearing BAX is shown in *Figure 6*.

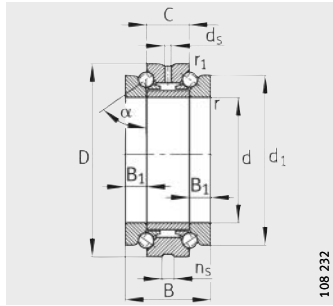


- ① Symbol indicating the load direction of the outer ring
- ② Trademark
- ③ Short designation (bearing designation)
- ④ Symbol for the largest wall thickness of the inner ring
- ⑤ Data matrix code
- ⑥ Actual value code for the bore

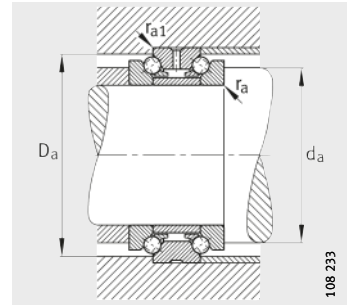
*Figure 6*  
Bearing marking of axial bearing BAX

# Axial angular contact ball bearings

Double direction



2344  
 $\alpha = 60^\circ$



Mounting dimensions

**Dimension table** - Dimensions in mm

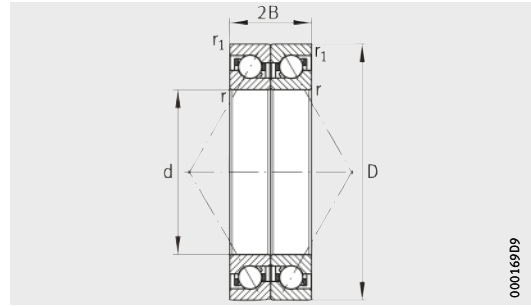
| Designation | Mass<br>m<br>≈ kg | Dimensions |     |     |    |                |                |     |                |                |                |
|-------------|-------------------|------------|-----|-----|----|----------------|----------------|-----|----------------|----------------|----------------|
|             |                   | d          | D   | B   | C  | d <sub>1</sub> | B <sub>1</sub> | r   | r <sub>1</sub> | d <sub>s</sub> | n <sub>s</sub> |
| 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 | 322            | 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           |

- 1) The lift-off force is the force at which the row of balls released from load by an axial force acting concentrically on the bearing becomes free of load.
- 2) The values are valid up to an axial force equal to 2,2% of the basic dynamic load rating C<sub>a</sub>.
- 3) Minimal quantity oil lubrication.

| Mounting dimensions |              |               |                  | Basic load ratings |                        | Limiting speeds                   |  | Preload force<br>$F_V$<br>N | Lift-off force <sup>1)</sup><br>$K_{aE}$<br>N | Axial rigidity <sup>2)</sup><br>$c_a$<br>N/ $\mu$ m |
|---------------------|--------------|---------------|------------------|--------------------|------------------------|-----------------------------------|--|-----------------------------|---|---|
| $d_a$<br>h12        | $D_a$<br>H12 | $r_a$<br>max. | $r_{a1}$<br>max. | dyn.<br>$C_a$<br>N | stat.<br>$C_{0a}$<br>N | $n_G$ grease<br>$\text{min}^{-1}$ | $n_G$ oil <sup>3)</sup><br>$\text{min}^{-1}$ |                             |   |   |
| 40,5                | 50,5         | 1             | 0,15             | 15 300             | 36 000                 | 11 000                            | 16 000                                       | 108                         | 308   | 276   |
| 46,5                | 57           | 1             | 0,15             | 18 900             | 47 000                 | 9 500                             | 14 000                                       | 134                         | 382   | 316   |
| 51,5                | 63,5         | 1             | 0,15             | 22 900             | 59 000                 | 8 500                             | 12 000                                       | 160                         | 456   | 354   |
| 57,5                | 70           | 1             | 0,15             | 25 000             | 67 000                 | 7 500                             | 10 000                                       | 180                         | 514   | 387   |
| 62,5                | 75           | 1             | 0,15             | 26 000             | 72 000                 | 7 000                             | 9 500  | 183                         | 522   | 410   |
| 69                  | 84,5         | 1,1           | 0,3              | 36 500             | 99 000                 | 6 300                             | 8 500  | 260                         | 743   | 458   |
| 74                  | 89,5         | 1,1           | 0,3              | 36 000             | 98 000                 | 6 000                             | 8 000  | 255                         | 728   | 455   |
| 79                  | 94,5         | 1,1           | 0,3              | 38 500             | 111 000                | 5 600                             | 7 500  | 275                         | 785   | 506   |
| 86,5                | 103,5        | 1,1           | 0,3              | 46 000             | 134 000                | 5 300                             | 7 000  | 325                         | 926   | 552   |
| 91,5                | 108,5        | 1,1           | 0,3              | 47 500             | 144 000                | 5 000                             | 6 700  | 340                         | 969   | 589   |
| 98,5                | 117          | 1,1           | 0,3              | 56 000             | 175 000                | 4 500                             | 6 000  | 400                         | 1 140   | 640   |
| 103,5               | 122          | 1,1           | 0,3              | 57 000             | 181 000                | 4 500                             | 6 000  | 400                         | 1 140   | 655   |
| 110,5               | 130,5        | 1,5           | 0,3              | 66 000             | 213 000                | 4 000                             | 5 300  | 465                         | 1 326   | 708   |
| 115,5               | 135,5        | 1,5           | 0,3              | 66 000             | 219 000                | 4 000                             | 5 300  | 465                         | 1 326   | 724   |
| 120,5               | 140,5        | 1,5           | 0,3              | 67 000             | 226 000                | 3 800                             | 5 000  | 685                         | 1 956   | 843   |
| 128                 | 150          | 2             | 0,6              | 74 000             | 250 000                | 3 600                             | 4 800  | 530                         | 1 511   | 775   |
| 134,5               | 160          | 2             | 0,6              | 98 000             | 325 000                | 3 400                             | 4 500  | 695                         | 1 983   | 853   |
| 144,5               | 170          | 2             | 0,6              | 101 000            | 345 000                | 3 200                             | 4 300  | 960                         | 2 736   | 996   |
| 159                 | 188          | 2             | 0,6              | 128 000            | 440 000                | 2 800                             | 3 800  | 900                         | 2 570   | 978   |
| 169                 | 198          | 2,1           | 0,6              | 132 000            | 470 000                | 2 600                             | 3 600  | 930                         | 2 649   | 1 034   |
| 181                 | 211,5        | 2,1           | 0,6              | 142 000            | 520 000                | 2 600                             | 3 600  | 1 320                       | 3 764   | 1 183   |
| 192,5               | 226          | 2,1           | 0,6              | 168 000            | 600 000                | 2 400                             | 3 400  | 1 180                       | 3 362   | 1 149   |
| 206,5               | 245          | 2,1           | 0,6              | 207 000            | 740 000                | 2 200                             | 3 200  | 1 847                       | 5 270   | 1 362   |
| 221                 | 263          | 2,1           | 0,6              | 235 000            | 840 000                | 2 000                             | 3 000  | 1 660                       | 4 733   | 1 315   |
| 231                 | 273          | 2,1           | 0,6              | 244 000            | 900 000                | 1 900                             | 2 800  | 2 110                       | 6 021   | 1 495   |
| 245                 | 291,5        | 2,1           | 0,6              | 285 000            | 1 060 000              | 1 800                             | 2 600  | 2 000                       | 5 704   | 1 449   |
| 269                 | 318          | 3             | 1                | 340 000            | 1 330 000              | 1 600                             | 2 200  | 2 400                       | 6 848   | 1 629   |
| 289                 | 338          | 3             | 1                | 350 000            | 1 420 000              | 1 500                             | 2 000  | 2 500                       | 7 134   | 1 729   |
| 317,5               | 374,5        | 4             | 1,5              | 400 000            | 1 680 000              | 1 400                             | 1 900  | 2 900                       | 8 257   | 1 814   |
| 337,5               | 394,5        | 4             | 1,5              | 415 000            | 1 790 000              | 1 300                             | 1 800  | 3 000                       | 8 542   | 1 920   |



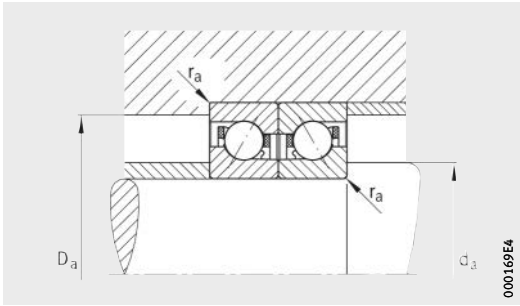
# Axial bearings BAX



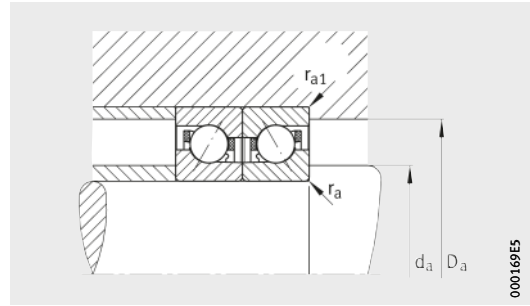
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**Dimension table** - Dimensions in mm

| Designation               | Mass<br>m<br>≈ kg | Dimensions |     |      |     |                | Contact angle<br>α<br>° | Mounting dimensions   |                       |                        |                 |
|---------------------------|-------------------|------------|-----|------|-----|----------------|-------------------------|-----------------------|-----------------------|------------------------|-----------------|
|                           |                   | d          | D   | B    | r   | r <sub>1</sub> |                         | d <sub>a</sub><br>h12 | D <sub>a</sub><br>H12 | r <sub>a</sub><br>max. | r <sub>a1</sub> |
| <b>BAX50-F-T-P4S-DBL</b>  | 0,5               | <b>50</b>  | 80  | 28,5 | 0,6 | 0,6            | 30                      | 57                    | 73                    | 0,6                    | 0,6             |
| <b>BAX50-H-T-P4S-DBL</b>  | 0,5               | <b>50</b>  | 80  | 28,5 | 0,6 | 0,6            | 40                      | 57                    | 73                    | 0,6                    | 0,6             |
| <b>BAX55-F-T-P4S-DBL</b>  | 0,74              | <b>55</b>  | 90  | 33   | 0,6 | 0,6            | 30                      | 63,5                  | 81,5                  | 0,6                    | 0,6             |
| <b>BAX55-H-T-P4S-DBL</b>  | 0,74              | <b>55</b>  | 90  | 33   | 0,6 | 0,6            | 40                      | 63,5                  | 81,5                  | 0,6                    | 0,6             |
| <b>BAX60-F-T-P4S-DBL</b>  | 0,8               | <b>60</b>  | 95  | 33   | 0,6 | 0,6            | 30                      | 68,5                  | 86,5                  | 0,6                    | 0,6             |
| <b>BAX60-H-T-P4S-DBL</b>  | 0,8               | <b>60</b>  | 95  | 33   | 0,6 | 0,6            | 40                      | 68,5                  | 86,5                  | 0,6                    | 0,6             |
| <b>BAX65-F-T-P4S-DBL</b>  | 0,84              | <b>65</b>  | 100 | 33   | 0,6 | 0,6            | 30                      | 73,5                  | 91,5                  | 0,6                    | 0,6             |
| <b>BAX65-H-T-P4S-DBL</b>  | 0,84              | <b>65</b>  | 100 | 33   | 0,6 | 0,6            | 40                      | 73,5                  | 91,5                  | 0,6                    | 0,6             |
| <b>BAX70-F-T-P4S-DBL</b>  | 1,18              | <b>70</b>  | 110 | 36   | 0,6 | 0,6            | 30                      | 80,5                  | 99,5                  | 0,6                    | 0,6             |
| <b>BAX70-H-T-P4S-DBL</b>  | 1,18              | <b>70</b>  | 110 | 36   | 0,6 | 0,6            | 40                      | 80,5                  | 99,5                  | 0,6                    | 0,6             |
| <b>BAX75-F-T-P4S-DBL</b>  | 1,24              | <b>75</b>  | 115 | 36   | 0,6 | 0,6            | 30                      | 85,5                  | 104,5                 | 0,6                    | 0,6             |
| <b>BAX75-H-T-P4S-DBL</b>  | 1,24              | <b>75</b>  | 115 | 36   | 0,6 | 0,6            | 40                      | 85,5                  | 104,5                 | 0,6                    | 0,6             |
| <b>BAX80-F-T-P4S-DBL</b>  | 1,68              | <b>80</b>  | 125 | 40,5 | 0,6 | 0,6            | 30                      | 91                    | 113,5                 | 0,6                    | 0,6             |
| <b>BAX80-H-T-P4S-DBL</b>  | 1,68              | <b>80</b>  | 125 | 40,5 | 0,6 | 0,6            | 40                      | 91                    | 113,5                 | 0,6                    | 0,6             |
| <b>BAX85-F-T-P4S-DBL</b>  | 1,98              | <b>85</b>  | 130 | 40,5 | 0,6 | 0,6            | 30                      | 96                    | 118,5                 | 0,6                    | 0,6             |
| <b>BAX85-H-T-P4S-DBL</b>  | 1,98              | <b>85</b>  | 130 | 40,5 | 0,6 | 0,6            | 40                      | 96                    | 118,5                 | 0,6                    | 0,6             |
| <b>BAX90-F-T-P4S-DBL</b>  | 2,3               | <b>90</b>  | 140 | 45   | 0,6 | 0,6            | 30                      | 102                   | 128                   | 0,6                    | 0,6             |
| <b>BAX90-H-T-P4S-DBL</b>  | 2,3               | <b>90</b>  | 140 | 45   | 0,6 | 0,6            | 40                      | 102                   | 128                   | 0,6                    | 0,6             |
| <b>BAX95-F-T-P4S-DBL</b>  | 2,4               | <b>95</b>  | 145 | 45   | 0,6 | 0,6            | 30                      | 107                   | 133                   | 0,6                    | 0,6             |
| <b>BAX95-H-T-P4S-DBL</b>  | 2,4               | <b>95</b>  | 145 | 45   | 0,6 | 0,6            | 40                      | 107                   | 133                   | 0,6                    | 0,6             |
| <b>BAX100-F-T-P4S-DBL</b> | 2,58              | <b>100</b> | 150 | 45   | 0,6 | 0,6            | 30                      | 112                   | 138                   | 0,6                    | 0,6             |
| <b>BAX100-H-T-P4S-DBL</b> | 2,58              | <b>100</b> | 150 | 45   | 0,6 | 0,6            | 40                      | 112                   | 138                   | 0,6                    | 0,6             |



Mounting dimensions

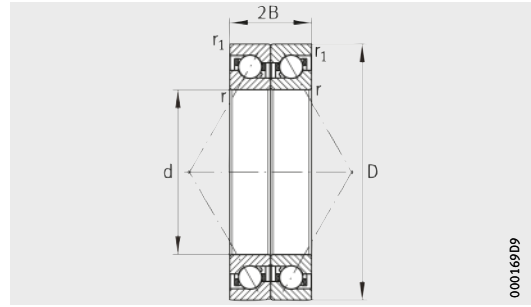


Mounting dimensions

| Basic load ratings  |                         | Limiting speeds                   |                                | Preload force<br>$F_v$ |        |        | Lift-off force<br>$K_{aE}$ |        |        | Axial rigidity<br>$c_a$ |                       |                       |
|---------------------|-------------------------|-----------------------------------|--------------------------------|------------------------|--------|--------|----------------------------|--------|--------|-------------------------|-----------------------|-----------------------|
| dyn.<br>$C_a$<br>kN | stat.<br>$C_{0a}$<br>kN | $n_G$ grease<br>$\text{min}^{-1}$ | $n_G$ oil<br>$\text{min}^{-1}$ | L<br>N                 | M<br>N | H<br>N | L<br>N                     | M<br>N | H<br>N | L<br>N/ $\mu\text{m}$   | M<br>N/ $\mu\text{m}$ | H<br>N/ $\mu\text{m}$ |
| 20 400              | 38 000                  | 13 000                            | 18 000                         | 84                     | 416    | –      | 241                        | 1 213  | –      | 123                     | 216                   | –                     |
| 25 000              | 50 000                  | 11 000                            | 15 000                         | 107                    | 595    | –      | 303                        | 1 708  | –      | 200                     | 361                   | –                     |
| 24 200              | 46 000                  | 11 000                            | 16 000                         | 88                     | 436    | –      | 252                        | 1 267  | –      | 129                     | 226                   | –                     |
| 30 000              | 61 000                  | 9 500                             | 14 000                         | 144                    | 741    | –      | 410                        | 2 128  | –      | 229                     | 401                   | –                     |
| 24 700              | 49 000                  | 11 000                            | 15 000                         | 110                    | 517    | –      | 313                        | 1 504  | –      | 143                     | 247                   | –                     |
| 30 500              | 64 000                  | 9 000                             | 13 000                         | 143                    | 747    | –      | 406                        | 2 146  | –      | 235                     | 415                   | –                     |
| 26 000              | 54 000                  | 10 000                            | 14 000                         | 120                    | 554    | –      | 342                        | 1 606  | –      | 148                     | 253                   | –                     |
| 31 500              | 70 000                  | 8 500                             | 12 000                         | 155                    | 792    | –      | 440                        | 2 269  | –      | 242                     | 424                   | –                     |
| 30 500              | 64 000                  | 9 000                             | 13 000                         | 149                    | 661    | –      | 426                        | 1 917  | –      | 164                     | 276                   | –                     |
| 37 000              | 84 000                  | 7 500                             | 11 000                         | 194                    | 944    | –      | 552                        | 2 703  | –      | 269                     | 462                   | –                     |
| 31 000              | 67 000                  | 8 500                             | 12 000                         | 149                    | 668    | –      | 426                        | 1 935  | –      | 168                     | 284                   | –                     |
| 37 500              | 88 000                  | 7 500                             | 10 000                         | 194                    | 955    | –      | 552                        | 2 734  | –      | 277                     | 477                   | –                     |
| 40 000              | 87 000                  | 8 000                             | 11 000                         | 217                    | 903    | –      | 620                        | 2 618  | –      | 195                     | 322                   | –                     |
| 49 000              | 114 000                 | 6 700                             | 9 500                          | 297                    | 1 323  | –      | 846                        | 3 791  | –      | 327                     | 545                   | –                     |
| 41 000              | 91 000                  | 7 500                             | 11 000                         | 220                    | 922    | –      | 629                        | 2 671  | –      | 202                     | 333                   | –                     |
| 50 000              | 119 000                 | 6 300                             | 9 000                          | 297                    | 1 332  | –      | 843                        | 3 816  | –      | 336                     | 561                   | –                     |
| 49 500              | 109 000                 | 7 000                             | 10 000                         | 300                    | 1 181  | –      | 856                        | 3 427  | –      | 221                     | 358                   | –                     |
| 61 000              | 142 000                 | 6 000                             | 8 500                          | 406                    | 1 700  | –      | 1 156                      | 4 871  | –      | 369                     | 602                   | –                     |
| 51 000              | 114 000                 | 6 700                             | 9 500                          | 296                    | 1 188  | –      | 847                        | 3 454  | –      | 235                     | 383                   | –                     |
| 62 000              | 149 000                 | 5 600                             | 8 000                          | 400                    | 1 711  | –      | 1 139                      | 4 910  | –      | 391                     | 643                   | –                     |
| 52 000              | 119 000                 | 6 300                             | 9 000                          | 299                    | 1 206  | –      | 854                        | 3 503  | –      | 242                     | 396                   | –                     |
| 63 000              | 156 000                 | 5 600                             | 8 000                          | 404                    | 1 740  | –      | 1 150                      | 4 991  | –      | 403                     | 665                   | –                     |



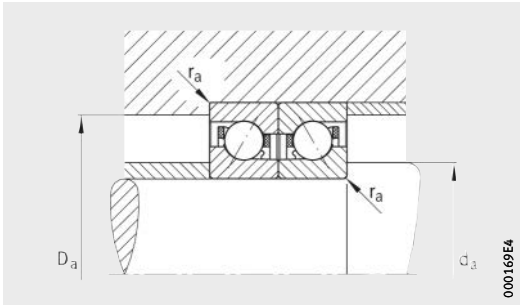
# Axial bearings BAX



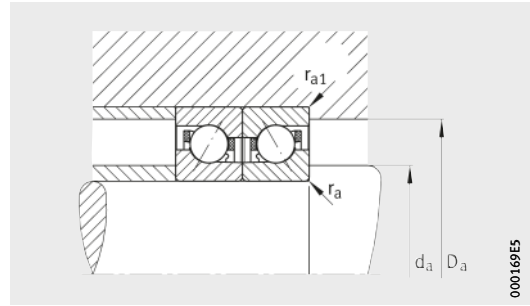
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**Dimension table** (continued) · Dimensions in mm

| Designation        | Mass<br>m<br>≈ kg | Dimensions |     |      |     |                | Contact angle<br>α<br>° | Mounting dimensions   |                       |                        |                 |
|--------------------|-------------------|------------|-----|------|-----|----------------|-------------------------|-----------------------|-----------------------|------------------------|-----------------|
|                    |                   | d          | D   | B    | r   | r <sub>1</sub> |                         | d <sub>a</sub><br>h12 | D <sub>a</sub><br>H12 | r <sub>a</sub><br>max. | r <sub>a1</sub> |
| BAX105-F-T-P4S-DBL | 3,2               | <b>105</b> | 160 | 49,5 | 1   | 1              | 30                      | 119,5                 | 145,5                 | 1                      | 1               |
| BAX105-H-T-P4S-DBL | 3,2               | <b>105</b> | 160 | 49,5 | 1   | 1              | 40                      | 119,5                 | 145,5                 | 1                      | 1               |
| BAX110-F-T-P4S-DBL | 4,12              | <b>110</b> | 170 | 54   | 1   | 1              | 30                      | 125,5                 | 154,5                 | 1                      | 1               |
| BAX110-H-T-P4S-DBL | 4,12              | <b>110</b> | 170 | 54   | 1   | 1              | 40                      | 125,5                 | 154,5                 | 1                      | 1               |
| BAX120-F-T-P4S-DBL | 4,42              | <b>120</b> | 180 | 54   | 1   | 1              | 30                      | 135,5                 | 164,5                 | 1                      | 1               |
| BAX120-H-T-P4S-DBL | 4,42              | <b>120</b> | 180 | 54   | 1   | 1              | 40                      | 135,5                 | 164,5                 | 1                      | 1               |
| BAX130-F-T-P4S-DBL | 6,54              | <b>130</b> | 200 | 63   | 1   | 1              | 30                      | 147,5                 | 182,5                 | 1                      | 1               |
| BAX130-H-T-P4S-DBL | 6,54              | <b>130</b> | 200 | 63   | 1   | 1              | 40                      | 147,5                 | 182,5                 | 1                      | 1               |
| BAX140-F-T-P4S-DBL | 6,96              | <b>140</b> | 210 | 63   | 1   | 1              | 30                      | 157,5                 | 192,5                 | 1                      | 1               |
| BAX140-H-T-P4S-DBL | 6,96              | <b>140</b> | 210 | 63   | 1   | 1              | 40                      | 157,5                 | 192,5                 | 1                      | 1               |
| BAX150-F-T-P4S-DBL | 8,2               | <b>150</b> | 225 | 67,5 | 1,1 | 1,1            | 30                      | 169                   | 206                   | 1,1                    | 1,1             |
| BAX150-H-T-P4S-DBL | 8,2               | <b>150</b> | 225 | 67,5 | 1,1 | 1,1            | 40                      | 169                   | 206                   | 1,1                    | 1,1             |
| BAX160-F-T-P4S-DBL | 10,6              | <b>160</b> | 240 | 72   | 1,1 | 1,1            | 30                      | 180,5                 | 219,5                 | 1,1                    | 1,1             |
| BAX160-H-T-P4S-DBL | 10,6              | <b>160</b> | 240 | 72   | 1,1 | 1,1            | 40                      | 180,5                 | 219,5                 | 1,1                    | 1,1             |
| BAX170-F-T-P4S-DBL | 13,4              | <b>170</b> | 260 | 81   | 1,1 | 1,1            | 30                      | 192,5                 | 237,5                 | 1,1                    | 1,1             |
| BAX170-H-T-P4S-DBL | 13,4              | <b>170</b> | 260 | 81   | 1,1 | 1,1            | 40                      | 192,5                 | 237,5                 | 1,1                    | 1,1             |
| BAX180-F-T-P4S-DBL | 17,8              | <b>180</b> | 280 | 90   | 1,1 | 1,1            | 30                      | 204                   | 255,5                 | 1,1                    | 1,1             |
| BAX180-H-T-P4S-DBL | 17,8              | <b>180</b> | 280 | 90   | 1,1 | 1,1            | 40                      | 204                   | 255,5                 | 1,1                    | 1,1             |
| BAX190-F-T-P4S-DBL | 18,6              | <b>190</b> | 290 | 90   | 1,1 | 1,1            | 30                      | 214                   | 265,5                 | 1,1                    | 1,1             |
| BAX190-H-T-P4S-DBL | 18,6              | <b>190</b> | 290 | 90   | 1,1 | 1,1            | 40                      | 214                   | 265,5                 | 1,1                    | 1,1             |
| BAX200-F-T-P4S-DBL | 24                | <b>200</b> | 310 | 99   | 1,1 | 1,1            | 30                      | 229                   | 280,5                 | 1,1                    | 1,1             |
| BAX200-H-T-P4S-DBL | 24                | <b>200</b> | 310 | 99   | 1,1 | 1,1            | 40                      | 229                   | 280,5                 | 1,1                    | 1,1             |



Mounting dimensions



Mounting dimensions

| Basic load ratings  |                         | Limiting speeds                   |                                | Preload force<br>$F_V$ |        |        | Lift-off force<br>$K_{aE}$ |        |        | Axial rigidity<br>$c_a$ |                       |                       |
|---------------------|-------------------------|-----------------------------------|--------------------------------|------------------------|--------|--------|----------------------------|--------|--------|-------------------------|-----------------------|-----------------------|
| dyn.<br>$C_a$<br>kN | stat.<br>$C_{0a}$<br>kN | $n_G$ grease<br>$\text{min}^{-1}$ | $n_G$ oil<br>$\text{min}^{-1}$ | L<br>N                 | M<br>N | H<br>N | L<br>N                     | M<br>N | H<br>N | L<br>N/ $\mu\text{m}$   | M<br>N/ $\mu\text{m}$ | H<br>N/ $\mu\text{m}$ |
| 53 000              | 125 000                 | 6 000                             | 8 500                          | 297                    | 1 216  | –      | 851                        | 3 539  | –      | 253                     | 416                   | –                     |
| 64 000              | 163 000                 | 5 300                             | 7 500                          | 396                    | 1 737  | –      | 1 126                      | 4 985  | –      | 418                     | 695                   | –                     |
| 64 000              | 151 000                 | 5 600                             | 8 000                          | 380                    | 1 495  | –      | 1 089                      | 4 351  | –      | 278                     | 451                   | –                     |
| 79 000              | 197 000                 | 4 800                             | 7 000                          | 524                    | 2 178  | –      | 1 492                      | 6 253  | –      | 466                     | 760                   | –                     |
| 66 000              | 164 000                 | 5 300                             | 7 500                          | 392                    | 1 554  | –      | 1 122                      | 4 519  | –      | 296                     | 481                   | –                     |
| 81 000              | 214 000                 | 4 500                             | 6 300                          | 543                    | 2 275  | –      | 1 546                      | 6 530  | –      | 496                     | 811                   | –                     |
| 90 000              | 215 000                 | 4 800                             | 7 000                          | 603                    | 2 235  | –      | 1 728                      | 6 510  | –      | 338                     | 538                   | –                     |
| 111 000             | 280 000                 | 4 000                             | 6 000                          | 850                    | 3 280  | –      | 2 420                      | 9 421  | –      | 570                     | 907                   | –                     |
| 94 000              | 235 000                 | 4 500                             | 6 700                          | 621                    | 2 317  | –      | 1 778                      | 6 743  | –      | 360                     | 573                   | –                     |
| 115 000             | 305 000                 | 3 800                             | 5 600                          | 865                    | 3 372  | –      | 2 463                      | 9 679  | –      | 604                     | 965                   | –                     |
| 101 000             | 260 000                 | 4 300                             | 6 000                          | 674                    | 2 494  | –      | 1 929                      | 7 255  | –      | 375                     | 596                   | –                     |
| 124 000             | 335 000                 | 3 600                             | 5 300                          | 938                    | 3 623  | –      | 2 670                      | 10 397 | –      | 630                     | 1 003                 | –                     |
| 112 000             | 290 000                 | 4 000                             | 5 600                          | 752                    | 2 764  | –      | 2 151                      | 8 038  | –      | 404                     | 641                   | –                     |
| 137 000             | 380 000                 | 3 400                             | 4 800                          | 1 052                  | 4 028  | –      | 2 994                      | 11 558 | –      | 681                     | 1 080                 | –                     |
| 142 000             | 365 000                 | 3 800                             | 5 300                          | 1 016                  | 3 609  | –      | 2 910                      | 10 501 | –      | 448                     | 701                   | –                     |
| 174 000             | 475 000                 | 3 200                             | 4 500                          | 1 447                  | 5 305  | –      | 4 120                      | 15 229 | –      | 758                     | 1 185                 | –                     |
| 178 000             | 455 000                 | 3 400                             | 5 000                          | 1 329                  | 4 610  | –      | 3 809                      | 13 418 | –      | 498                     | 775                   | –                     |
| 219 000             | 590 000                 | 3 000                             | 4 300                          | 1 910                  | 6 798  | –      | 5 437                      | 19 520 | –      | 846                     | 1 310                 | –                     |
| 182 000             | 475 000                 | 3 400                             | 4 800                          | 1 082                  | 4 261  | –      | 3 095                      | 12 375 | –      | 477                     | 773                   | –                     |
| 223 000             | 620 000                 | 2 800                             | 4 000                          | 1 503                  | 6 245  | –      | 4 276                      | 17 913 | –      | 801                     | 1 306                 | –                     |
| 184 000             | 500 000                 | 3 200                             | 4 500                          | 1 089                  | 4 312  | –      | 3 115                      | 12 518 | –      | 490                     | 796                   | –                     |
| 226 000             | 650 000                 | 2 600                             | 3 800                          | 1 501                  | 6 286  | –      | 4 269                      | 18 024 | –      | 822                     | 1 343                 | –                     |





## Customer solutions



# Customer solutions

|                                    | Page  |
|------------------------------------|---|
| <b>Spindle bearings</b>            | Spring preloaded non-locating bearing units ..... 236   |
|                                    | Thin dense chromium coating on outside diameter..... 238  |
|                                    | Open spindle bearings supplied greased ..... 239  |
| <b>Cylindrical roller bearings</b> | Cylindrical roller bearings with cylindrical bore and special radial internal clearance ..... 240 |



## Customer solutions

The dimension tables in this catalogue cover spindle bearings corresponding to the standardised design envelope.

The chapter Customer solution presents solutions with ordering designations that allow these spindle bearing products to be adapted as well as possible to the mounting situation on the spindle. The products do not fall outside the standardised design envelope. They can thus be used without any problems in new designs with existing spindle configurations.

Due to the system of series designations, the bearing type from which the product is derived is retained in the ordering designation. This also takes account of the fundamental series philosophy underlying these special solutions, which stands for speed, flexibility and security of supply.

Furthermore, any type of bearing design is available by agreement as a special solution with a drawing number.

### **Spindle bearings Spring preloaded non-locating bearing units**

Spring preloaded non-locating -bearing units SPP, “Spring Preloaded”, are standard spindle bearings in which the outer ring is twice the width of the standard outer ring, *Figure 1* and *Figure 2*, page 237. In addition, the bearing ring has holes for flat spiral springs and an anti-rotation device. This gives a ready-to-fit, spring preloaded unit. The preload can be individually set by means of the adjustment and number of the springs.

The outer ring has a thin dense chromium coating. This ensures good, secure sliding function in the housing for the long term. The sliding function of the spring preloaded non-locating unit is also supported by the outer ring with twice the width of the bearing.

The tolerances of these bearings correspond to P4S.

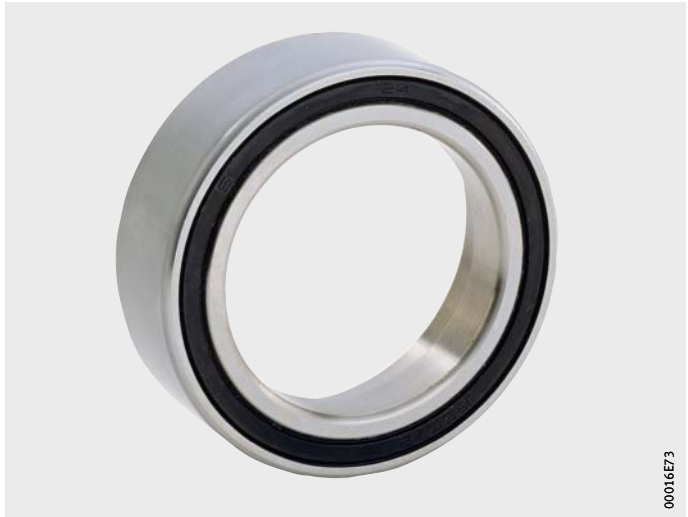
All spindle bearing designs, such as contact angle, hybrid, Cronidur, steel, DLR, sealed and other application-specific product designs can be ordered under the designation SPP.

*Figure 1*  
Spring preloaded  
non-locating bearing unit



00016E74

*Figure 2*  
Sealed spring preloaded  
non-locating bearing unit



00016E73



## Customer solutions

### Thin dense chromium coating on outside diameter

In order to prevent fretting corrosion on the outer ring, spindle bearings with the ordering designation J24J have a thin dense chromium coating on the outer ring, *Figure 3*. Due to this thin dense chromium coating, the friction coefficient between the housing and outer ring remains consistently low during operation.

Since the thin dense chromium coating is taken into consideration in the manufacture of the outer rings, all tolerances conform to P4S. The bandwidth of the outside diameter sort is maintained. As a result, coated bearings can be used on existing spindles without modification of the adjacent construction.

Ordering example

**HCB7014-E-T-P4S-J24J-UL**



*Figure 3*  
Thin dense chromium coating on outside diameter

## Open spindle bearings supplied greased

Open spindle bearings supplied filled with the optimum grease quantity can be ordered using the designations GA21, L298 and L055.

The advantages of these designs are that greasing by the customer is not required and the correct grease in the correct quantity for the application is available at the correct position in the bearing without losing any time during mounting.



If the grease is not retained in the bearing by adjacent parts, it is recommended that sealed spindle bearings should be used. When selecting bearings, the Application Engineering facilities of Schaeffler Technologies should be contacted for assistance.

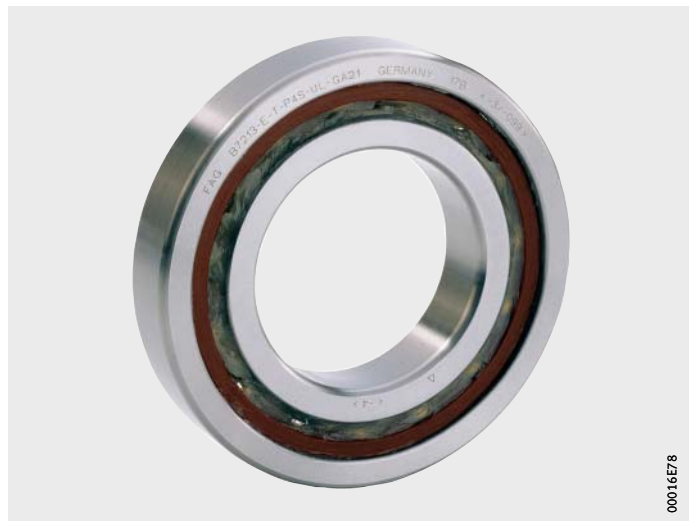
Ordering examples

**HCB7014-E-T-P4S-UL-GA21**

**HCB7014-E-T-P4S-UL-L298**

Greased with Arcanol GA21

*Figure 4*  
Open spindle bearing



Greased with Arcanol L298

*Figure 5*  
Open spindle bearing



## Customer solutions

### Cylindrical roller bearings Cylindrical bore and special radial internal clearance

Cylindrical roller bearings are also available by agreement with a cylindrical bore.

In the case of these bearings, there is no “K” in the short designation, see examples in brackets:

- N10..K-M1-SP (N10..-M1-SP)
- N10..K-PVPA1-SP (N10..-PVPA1-SP)
- N10..K-HS-PVPA1-SP (N10..-HS-PVPA1-SP)
- HCN10..K-PVPA1-SP (HCN10..-PVPA1-SP)
- N19..K-M1-SP (N19..-M1-SP).

If these bearings are planned for use at high speeds, the Application Engineering facilities should be contacted for assistance in order to achieve the correct design.

The radial internal clearance tables for cylindrical roller bearings with a cylindrical bore contain standardised values. At high speeds, it may be the case that if the interference of the inner ring required to prevent the inner ring from lifting off the shaft is present, the cylindrical roller bearing with a cylindrical bore will run with preload after mounting. In this case, the radial internal clearance of the cylindrical roller bearing must be redefined with the assistance of Application Engineering.

Ordering example

**HCN1014-PVPA1-SP-R15-30NA**



Cylindrical bore and  
special radial internal clearance

*Figure 6*  
Super precision  
cylindrical roller bearings



# Request for calculation of bearing arrangement



Schaeffler Technologies AG & Co. KG  
Product Line Spindle Bearings

Design no.: \_\_\_\_\_ Customer: \_\_\_\_\_  
 Drawing attached:  yes  no Contact: \_\_\_\_\_  
 Bearing arrangement (diagram, for example <<>): Application: \_\_\_\_\_  
 \_\_\_\_\_ Drive system: \_\_\_\_\_

Rigid  Shaft position: vertical   
 Spring-adjusted  horizontal   
 Spring force \_\_\_\_\_ swivelling   
 Bearing type(s) on working side (front): \_\_\_\_\_ Bearing type(s) on drive side (rear): \_\_\_\_\_

Max. speed: \_\_\_\_\_ min<sup>-1</sup> Lubrication: \_\_\_\_\_ Nominal viscosity: \_\_\_\_\_ mm<sup>2</sup> · s<sup>-1</sup>

| Forces               |                      |                      | Speed | Time proportion | Tool diameter | Boom | Belt tension, drive |                   |
|----------------------|----------------------|----------------------|-------|-----------------|---------------|------|---------------------|-------------------|
| F <sub>r</sub><br>kN | F <sub>a</sub><br>kN | F <sub>t</sub><br>kN |       |                 |               |      |                     | min <sup>-1</sup> |
|                      |                      |                      |       |                 |               |      |                     |                   |
|                      |                      |                      |       |                 |               |      |                     |                   |
|                      |                      |                      |       |                 |               |      |                     |                   |
|                      |                      |                      |       |                 |               |      |                     |                   |
|                      |                      |                      |       |                 |               |      |                     |                   |

Special environmental influences, operating conditions: \_\_\_\_\_ Assumptions: \_\_\_\_\_  
 Bearing operating temperature front/rear: T= \_\_\_\_\_ / \_\_\_\_\_ °C  
 ΔT (inner ring/outer ring) front/rear: \_\_\_\_\_ / \_\_\_\_\_ K  
 Interference (shaft/inner ring) front/rear: \_\_\_\_\_ / \_\_\_\_\_ μm

Bearing spacing l = \_\_\_\_\_ mm, drive spacing b = \_\_\_\_\_ mm, boom a = \_\_\_\_\_ mm (see table)



Questions (please attach drawing if possible):  
 \_\_\_\_\_  
 \_\_\_\_\_

Contact: \_\_\_\_\_ Date: \_\_\_\_\_

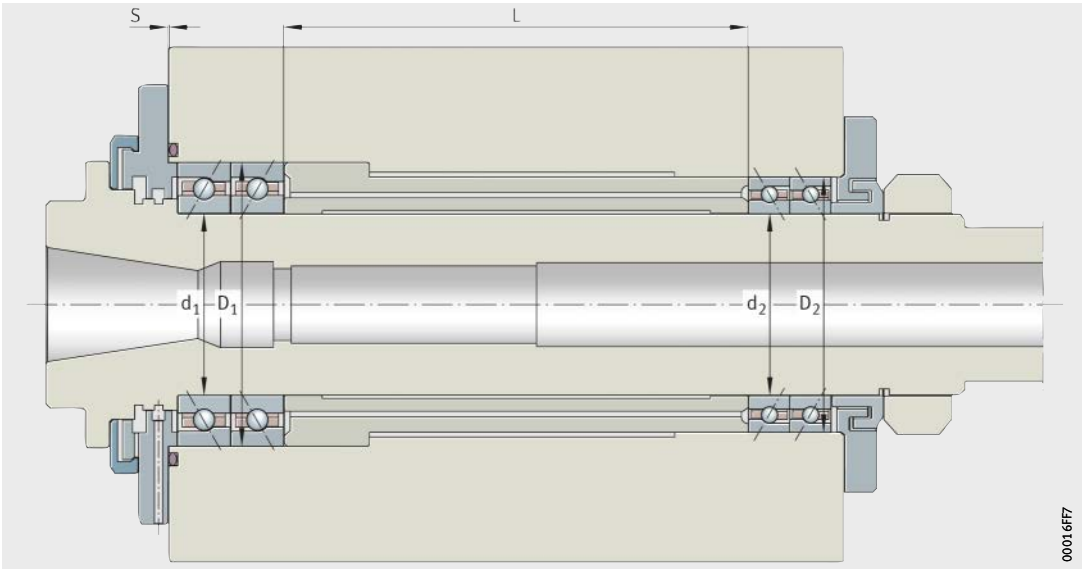
This form is also available in electronic form at [www.fag.de](http://www.fag.de).



# Checklist for mounting of spindle bearings



## Milling spindle (example)



00016FF7

**Bearing seat diameter  $d_1, D_1, d_2, D_2$**

|         |                                   |                      |                     |
|---------|-----------------------------------|----------------------|---------------------|
| Spindle | $\varnothing 70 \pm 0,004$        | front $d_1 = +0,002$ | rear $d_2 = 0$      |
| Housing | $\varnothing 110 -0,004 / +0,006$ | front $d_1 = +0,003$ | rear $d_2 = +0,003$ |

**Difference in length L** between intermediate sleeves    max.  $\pm 0,002$     actual: 0

**Gap S** before screw tightening    nominal 0,01 to 0,03    actual: 0,02

**Balancing of rotational parts**     OK

**Spindle bearing front**    Part designation: **HC7014-E-T-P4S-UL**

**Spindle bearing rear**    Part designation: **HC7014-E-T-P4S-UL**

**Correct designation**     OK     Other: \_\_\_\_\_

**Special notes** \_\_\_\_\_

**Grease quantity** per bearing 9,2 cm<sup>3</sup>     OK     Other: \_\_\_\_\_

**Nut tightening torque, initially three times value**    219 Nm     OK, loosen, then

**Nut tightening torque, finally one times value**    73 Nm     OK

**Grease distribution cycle** completed     OK

**Continuous running** completed, speed    10 000 min<sup>-1</sup>     OK

**Equilibrium temperature**    +44 °C

**Room temperature**    +24 °C

**Note**    The difference should (without cooling) not exceed +30 K.

**Radial runout**  $R_{max}$  0,002    Actual: 0,001

**Axial runout**  $A_{max}$  0,002    Actual: 0,001

**Machine:**    Machining centre – customer    **Spindle:** Drawing, serial number

Location: \_\_\_\_\_ Date: \_\_\_\_\_ Fitter: \_\_\_\_\_



# Checklist for mounting of spindle bearings



Spindle name and application: \_\_\_\_\_



**Bearing seat diameter  $d_1, D_1, d_2, D_2$**

Spindle  $\varnothing$  \_\_\_\_\_ front  $d_1 =$  \_\_\_\_\_ rear  $d_2 =$  \_\_\_\_\_  
 Housing  $\varnothing$  \_\_\_\_\_ front  $D_1 =$  \_\_\_\_\_ rear  $D_2 =$  \_\_\_\_\_

**Difference in length L** between intermediate sleeves max. \_\_\_\_\_ actual: \_\_\_\_\_  
**Gap S** before screw tightening nominal \_\_\_\_\_ to \_\_\_\_\_ actual: \_\_\_\_\_

**Balancing of rotational parts**  OK

**Spindle bearing front** Part designation: \_\_\_\_\_  
**Spindle bearing rear** Part designation: \_\_\_\_\_

**Correct designation**  OK  Other: \_\_\_\_\_

**Special notes** \_\_\_\_\_

**Grease quantity** per bearing \_\_\_\_\_  $\text{cm}^3$   OK  Other: \_\_\_\_\_

**Nut tightening torque, initially three times value** \_\_\_\_\_ Nm  OK, loosen, then  
**Nut tightening torque, finally one times value** \_\_\_\_\_ Nm  OK

**Grease distribution cycle** completed  OK

**Continuous running** completed, speed \_\_\_\_\_  $\text{min}^{-1}$   OK

**Equilibrium temperature** \_\_\_\_\_  $^{\circ}\text{C}$

**Room temperature** \_\_\_\_\_  $^{\circ}\text{C}$

**Note** \_\_\_\_\_

**Radial runout**  $R_{\text{max}}$  \_\_\_\_\_ Actual: \_\_\_\_\_

**Axial runout**  $A_{\text{max}}$  \_\_\_\_\_ Actual: \_\_\_\_\_

**Machine:** \_\_\_\_\_ **Spindle:** \_\_\_\_\_

Location: \_\_\_\_\_ Date: \_\_\_\_\_ Fitter: \_\_\_\_\_

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