Precision Rolling Bearings for Ball Screws

TI-I-5010.3 / E

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IBC WÄLZLAGER GMBH
INDUSTRIAL BEARINGS AND COMPONENTS
POSTFACH 18 25 · 35528 WETZLAR (GERMANY)

Tel.: +49 64 41 95 53-02
Fax: +49 64 41 5 30 15

Industriegebiet Oberbiel
D-35606 Solms-Oberbiel

ibc@ibc-waelzlager.com
www.ibc-waelzlager.com

IBC INDUSTRIAL BEARINGS
AND COMPONENTS AG

Tel.: +41 32 6 52 83 53
Fax: +41 32 6 52 83 58

Kapellstrasse 26
CH-2540 Grenchen

ibc@ibcag.ch
www.ibc-waelzlager.com

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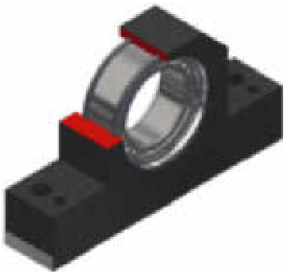

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2. Introduction

IBC Wälzlager GmbH, **Industrial Bearings and Components**, has been offering for decades now a comprehensive application-oriented range of easy-to-install solutions, especially for the bearings of ball screws (BS) or satellite screw drives, the scope of which is being further developed continuously and successfully.

Ball screws are proven components for converting a rotary motion into a linear one, or vice versa. The inherent system advantages of ball screws are very high precision, low friction and the ability to implement high speeds of movement. Today ball screws are predominantly used in high-quality machine tools and in machine and apparatus construction. New types with high-precision accuracy and higher load ratings are being employed in ever more innovative application areas.

The IBC product range covers a complete range of bearings for ball screws and to seal and fix rolling bearings. In addition to **precision 60° ball screw support bearings** as individual bearings or in bearing sets, complete **precision bearing units**, such as flange units, pillow block units or floating bearing units for various applications are also offered. **Precision locknuts**, with or without integrated labyrinth seals and **labyrinth seals** complete the comprehensive range offered.

EXAD - the performance-optimized formula - fulfils a commitment to meeting the requirements for longer lifetimes, higher rotating speeds and better running properties and has been expanded to include the range of precision 60° ball screw support bearings. Optimization of the design, the materials and production procedures has resulted in a marked improvement of the lifetime and service life, functional safety, durability and running properties while at the same time reducing friction and hence achieving less heat development. Improvements in all industrial applications regarding functionality, economy and reliability have been achieved together with a simultaneous reduction in friction.

IBC also produces **double-row EXAD 60° ball screw support bearings of the BSDF series** in flanged form in addition to **single-row EXAD 60° ball screw support bearings** of the **BS series** and **double-row EXAD 60° ball screw support bearings** of the **BSD series** for mounting in housings. They provide for the user high-precision and low-friction bearings that are able to carry heavy loads for use with ball screw spindles.

In conjunction with the ease of mounting and low maintenance required, this provides a degree of optimization for the entire machine tool.

The IBC range of products for bearings for ball screws is rounded out by a comprehensive range of **precision bearing units**. In these bearing units the EXAD 60° ball screw support bearings are available in ready-mounted form, either in individual bearings or as bearing sets. A variable modular system has been developed so as to be able to offer an optimal solution for the wide variety of possible applications, thus giving the designer the maximum amount of freedom, for example, in offering variations on the design. **Bearing units that are ready to install** are increasingly popular.

IBC precision locating bearing units are available in the **BSBU** and **BSPB series** for ball screw spindle end series and in the **BNBU** and **BNPB series** for the ball screw nut bearings as flanged bearing or pillow block units in various bearing arrangements and preloading classes**. IBC precision locating bearing units with built-in precision locknuts of the BSBU-M** and **BSPB-M series** complete the range.

In addition, **IBC precision floating bearing units** of the **BLBU** flange unit series and the **pillow block units** of the **BLPB** series provide options for bearings for longer ball screw spindles. **Spring-preloaded floating bearing units** of the **BSBU ... D ... DTB + PLS** and **BSPB ... D ... DT-B + PLS** series can be used to increase the stiffness and critical rotating speed of longer ball screw spindles.

Separate nuts with axial or radial locking are offered for precision bearing units without built-in locknuts. **IBC precision labyrinth seals S** or **IBC precision labyrinth seals MMRS** can be used to provide an optimal seal.

The comprehensive IBC range has been expanded to include **ATCoat coated precision rolling bearings** for applications in which there are very slow movements, only limited swivelling movements are made, or in other special application cases. The advantages of **ATCoat coated precision rolling bearings** are a longer working life and excellent wear- and corrosion-resistant properties.

IBC components for bearings for ball screws make a convincing case and offer a multitude of advantages.

- **Reducing in mounting effort** – Bearing units that are ready to install can be fitted without time-consuming setting up and thus simplify the mounting of the associated assemblies. The configurations of the bearings with the same reference dimensions make both mounting and construction much easier.

- **Ease of maintenance** – Since **IBC precision bearing units** are lubricated for life and have labyrinth seals, this greatly reduces the amount of maintenance required Alternatively, versions with circulating oil lubrication can be used. The amount of service work is greatly reduced by the ability to replace complete bearing units.

- **Suitable for high rotating speeds** - Compared to rolling bearings with rollers, low-friction EXAD **precision 60° ball screw support bearings,** in connection with non-contact seals, permit significantly higher rotating speeds and hence higher speeds of movement. If required, ceramic balls can be used to increase rotating speeds further.

- **High axial (load) capacity and stiffness** – EXAD **precision 60° ball screw support bearings** place an emphasis on the transmission of high axial loads and axial stiffness. This is reflected in the high load ratings of the rolling bearings.

- **Appropriate preloading for the application** – Versions with various preload levels are available to suit individual application demands.

- **High positioning precision** – The excellent running with precision allows high precision of positioning.

- **Reliability** – In connection with lifetime lubrication and contact-type or non-contact seals, this gives very high reliability, which is reflected in turn in a high level of operational safety.

Discover the advantages of EXAD in connection with an effective use of materials and saving of energy. This achieves an optimal combination of technology and economic efficiency.

In addition to the standard range of products with precision flange and pillow block units IBC produces a wide variety of **special solutions** that are matched to individual customer requirements.

Our technical department would be glad to help you in such matters. We look forward to your inquiry.

Fig. 2.1: Components of an IBC precision pillow block unit BSPB-M, consisting of a precision locknut MMRS and a precision seal ring locknut MD, four single-row 60° ball screw support bearings, precision labyrinth seal S and precision pillow block housing

3. Selection, design and calculation

3.1 Load carrying capacity and working life

The radial and axial load portions are summarized for determination of the lifetime in accordance with DIN ISO 281 according to the following formulas for dynamic equivalent axial load P_a and for the static equivalent axial load P_{oa}.

$$P_a = X \cdot F_r + Y \cdot F_a \qquad [N] \quad [3.1]$$

$$P_{oa} = X_o \cdot F_r + Y_o \cdot F_a \qquad [N] \quad [3.2]$$

P_a	dynamic equivalent axial load	[N]
P_{oa}	static equivalent axial load	[N]
F_r	radial components of the load	[N]
F_a	axial components of the load	[N]
X, X_o	dynamic and static radial factors of the rolling bearing	
Y, Y_o	dynamic and static axial factors of the rolling bearing	

For single bearings <, tandem arrangement << and multiple arrangement in one direction <<<<, <<<<<, ...						**Single bearings in X- > < - arrangement or O- < > - arrangement; two-row rolling bearings < >**					
$\frac{F_a}{F_r} \leq 2{,}17$		$\frac{F_a}{F_r} > 2{,}17$				$\frac{F_a}{F_r} \leq 2{,}17$		$\frac{F_a}{F_r} > 2{,}17$			
X	**Y**	**X**	**Y**	**X_0**	**Y_0**	**X**	**Y**	**X**	**Y**	**X_0**	**Y_0**
inadequate		0.92	1	4	1	1.9	0.55	0.92	1	4	0.58

Table 3.1: Radial and axial load factors X, Y, X_o, Y_o

Radial loading of the individual bearing F_{rE}

The radial loading is distributed over all the rolling bearings in the set. Here belt forces can generally be ignored.

$$F_{rE} = \frac{F_r}{i^{0,7}} \qquad [N] \quad [3.3]$$

F_{rE} radial loading of the individual bearing [N]

Number of rolling bearings in the set					
i	2	3	4	5	6
$i^{0,7}$	1.62	2.16	2.64	3.09	3.51

Table 3.2: Load rating factors for bearing sets, radial loading of the individual bearing F_{rE} with i rolling bearings

Bearing combinations

The static and dynamic axial load ratings of multiple ball screw support bearings that are loaded in the same direction is calculated as follows:

$$C_{a\,Set} = i^{0,7} \cdot C_{aE} \qquad [N] \quad [3.4]$$

$$C_{oa\,Set} = i \cdot C_{oaE} \qquad [N] \quad [3.5]$$

Static load safety:

$$S_{oa} = C_{oa}/P_{oa} \text{ (select } S_{oa} > 2{,}5) \qquad [3.6]$$

$C_{a\,Set}$	dynamic axial load rating in the bearing set	[N]
C_{aE}	dynamic axial load rating of the individual bearing	[N]
$C_{oa\,Set}$	static axial load rating in the bearing set	[N]
C_{oa}	static axial load rating	[N]
C_{oaE}	static axial load rating of the individual bearing	[N]
F_v	preload of individual bearing	[N]
S_{oa}	static load safety	
F_{ae}	resulting outer axial load on the entire bearing arrangement	[N]
F_{aE}	resulting axial load of the individual bearing	[N]
i	number of bearings in axial load direction	

Fig. 3.1: Single-row IBC precision 60° ball screw support bearings, BS series, in various bearing arrangements

Load direction > A	Arrangement bearing position A	B	Load direction B <	Preloading direction unloading faktor X for $F_{ae} > X \cdot F_v$ X	Load distribution related to the individual bearing F_{aE}: up until unloading for $F_{ae} < X \cdot F_v$ A	B	after unloading for $F_{ae} > X \cdot F_v$ A	B
$F_{ae} \rightarrow$	<	>		2.83	$F_V + 0.67\ F_{ae}$ [3.7]	$F_V - 0.33\ F_{ae}$ [3.8]	F_{ae}	0
$F_{ae} \rightarrow$	<<	>		5.66	$0.84\ F_v + 0.47\ F_{ae}$ [3.9]	$1.36\ F_V - 0.24\ F_{ae}$ [3.10]	$0.617\ F_{ae}$	0
	<<	>	$\leftarrow F_{ae}$	2.83	$0.84\ F_V - 0.30\ F_{ae}$ [3.11]	$1.36\ F_V + 0.52\ F_{ae}$ [3.12]	0	F_{ae}
$F_{ae} \rightarrow$	<<<	>		8.49	$0.73\ F_V + 0.38\ F_{ae}$ [3.13]	$1.57\ F_V - 0.18\ F_{ae}$ [3.14]	$0.463\ F_{ae}$	0
	<<<	>	$\leftarrow F_{ae}$	2.83	$0.73\ F_V - 0.26\ F_{ae}$ [3.15]	$1.57\ F_V + 0.45\ F_{ae}$ [3.16]	0	F_{ae}
$F_{ae} \rightarrow$	<<<<	>		11.30	$0.65\ F_V + 0.32\ F_{ae}$ [3.17]	$1.71\ F_v - 0.15\ F_{ae}$ [3.18]	$0.379\ F_{ae}$	0
	<<<<	>	$\leftarrow F_{ae}$	2.83	$0.65\ F_V - 0.23\ F_{ae}$ [3.19]	$1.71\ F_V + 0.45\ F_{ae}$ [3.20]	0	F_{ae}
$F_{ae} \rightarrow$	<<<<<	>		14.15	$0.59\ F_V + 0.28\ F_{ae}$ [3.21]	$1.82\ F_V - 0.13\ F_{ae}$ [3.22]	$0.324\ F_{ae}$	0
	<<<<<	>	$\leftarrow F_{ae}$	2.83	$0.59\ F_V - 0.21\ F_{ae}$ [3.23]	$1.82\ F_V + 0.36\ F_{ae}$ [3.24]	0	F_{ae}
$F_{ae} \rightarrow$	<<	>>		5.66	$1.23\ F_V + 0.40\ F_{ae}$ [3.25]	$1.23\ F_V - 0.22\ F_{ae}$ [3.26]	$0.617\ F_{ae}$	0
$F_{ae} \rightarrow$	<<<	>>		8.49	$1.12\ F_V + 0.33\ F_{ae}$ [3.27]	$1.49\ F_V - 0.18\ F_{ae}$ [3.28]	$0.463\ F_{ae}$	0
	<<<	>>	$\leftarrow F_{ae}$	5.66	$1.12\ F_V - 0.20\ F_{ae}$ [3.29]	$1.49\ F_V + 0.35\ F_{ae}$ [3.30]	0	$0.617\ F_{ae}$
$F_{ae} \rightarrow$	<<<<	>>		11.30	$1.03\ F_V + 0.29\ F_{ae}$ [3.31]	$1.68\ F_V - 0.15\ F_{ae}$ [3.32]	$0.379\ F_{ae}$	0
	<<<<	>>	$\leftarrow F_{ae}$	5.66	$1.03\ F_V - 0.18\ F_{ae}$ [3.33]	$1.68\ F_V + 0.33\ F_{ae}$ [3.34]	0	$0.617\ F_{ae}$
$F_{ae} \rightarrow$	<<<	>>>		8.49	$1.39\ F_V + 0.30\ F_{ae}$ [3.35]	$1.39\ F_V - 0.16\ F_{ae}$ [3.36]	$0.463\ F_{ae}$	0
$F_{ae} \rightarrow$	<<<<	>>>		11.30	$1.30\ F_V + 0.26\ F_{ae}$ [3.37]	$1.62\ F_V + 0.14\ F_{ae}$ [3.38]	$0.379\ F_{ae}$	0
	<<<<	>>>	$\leftarrow F_{ae}$	8.49	$1.30\ F_V - 0.15\ F_{ae}$ [3.39]	$1.62\ F_V + 0.28\ F_{ae}$ [3.40]	0	$0.463\ F_{ae}$
$F_{ae} \rightarrow$	<<<<	>>>>		11.30	$1.52\ F_V + 0.24\ F_{ae}$ [3.41]	$1.52\ F_V - 0.35\ F_{ae}$ [3.42]	$0.379\ F_{ae}$	0

Table 3.3: Resulting axial load F_{aE} of the individual bearing for various arrangements as a function of the ground-in preload F_v and the outer loading F_{ae}

Axial loading of the individual bearing F_{aE}

The axial loading related to the individual bearings can be found from formulas 3.7 to 3.44. Only the rolling bearings in the direction of the load can bear a certain proportion of the load. The rolling bearings in the opposite direction to the load bear a different proportion of the load or even no load once the preload $X \cdot F_v$ has been overcome.

In the double-row bearings BSD(F).BM the formulas 3.7 and 3.8 are to be applied with preload F_v and in the case of four-row rolling bearings BSD(F)…DBM-2 can be determined approximately with formulas 3.25 and 3.26 with half the preload F_v from pages 25 on.

Dynamic equivalent axial load P_a

Using F_{rE} and F_{aE} the dynamic equivalent axial load P_a is determined on the basis of formula 3.1. In the case of axial bearing loading, in addition to the outer load F_{ae} the bearing preload F_v must be taken into consideration. Since the forces F_v and F_{ae} have already been taken specified per individual bearing in Table 3.3 and according to the formulae 3.7 to 3.42, the load rating of the individual bearing is used for further calculation of the nominal working life for spindles, in which various loads can be applied in the +/- axis direction, it is necessary to check the lifetime for both directions. In the case of spring-preloaded bearings this applies to the bearing (package) that is stressed more heavily:

$$F_a = F_{Spring} + F_{ae} \qquad [N] \qquad [3.43]$$

$$F_{aE} = \frac{1}{i_{0,7}} \cdot (F_{Spring} + F_{ae}) \qquad [N] \qquad [3.44]$$

F_{Spring} Spring force [N]

$$P_{ma} = \sqrt[3]{\frac{P_{a1}^3 \cdot t_1 \cdot n + \ldots + P_{an}^3 \cdot t_n \cdot n_n}{n_m \cdot 100}} \qquad [N] \qquad [3.45]$$

$$n_m = \frac{t_1 \cdot n_1 + \ldots + t_n \cdot n_n}{100} \quad \text{bis } t_n \text{ in } [\%] \qquad [rpm] \qquad [3.46]$$

P_{ma}	medium dyn. equiv. load axial	[N]
$P_{a1} .. P_{an}$	dyn. equiv. load per load case	[N]
$t_1 .. t_n$	time portion	[%]
$n_1 .. n_n$	speed	[rpm]
n_m	medium speed of rotation	[rpm]

Nominal lifetime $L_{10,h}$

The point in time at which there are still no signs of material fatigue for 90 % of rolling bearings of the same type is calculated with $L_{10,h}$.

$$L_{10,h} = \left(\frac{C_a}{P_{ma}}\right)^p \cdot \frac{1.000.000}{60 \cdot n_m} \quad [h] \quad [3.47]$$

$L_{10,h}$	nominal lifetime	[h]
N_m	medium rpm	[rpm]
C_a	dynamic load rating, axial, individual bearing	[N]
P	lifetime exponent for ball bearings p = 3	

Extended modified lifetime $L_{nm,h}$

The calculation of the lifetime of high-precision rolling bearings has been refined in the course of time by using new criteria. The modified lifetime $L_{10,nm}$ takes into consideration the lubrication state, the potential contamination of the bearing position and the material fatigue limit and is calculated in accordance with DIN ISO 281.

$$L_{nm,h} = a_1 \cdot a_{ISO} \cdot L_{10,h} \quad [h] \quad [3.48]$$

$L_{nm,h}$	extended modified lifetime	[h]
a_1	lifetime expectation as per Table 3.4	
a_{ISO}	life cycle coefficient in accordance with formulas 3.55 to 3.57	

Lifetime expectation a_1		
expectation in %	L_{na}	a_1
90	L_{10a}	1.00
95	L_{5a}	0.64
96	L_{4a}	0.55
97	L_{3a}	0.47
98	L_{2a}	0.37
99	L_{1a}	0.25

Table 3.4: Lifetime expectation coefficients a_1 in accordance with DIN ISO 281

The introduced a_{ISO}- factor comprises the various following influencing variables:

Influence	affected
Lubrication	Bearing size, speed of rotation, viscosity and type of lubrication, additives
Material	Surface, purity, hardness, temperature resistance, fatigue limit
Bearing construction	Friction relationships, internal load distribution
Tension	Production, heat treatment, interference fit
Environment	Moisture, impurities in the lubrication
Mounting	Misalignment, damage

Table 3.5: Parameters influencing the lifetime

The extended modified lifetime is based on the nominal lifetime $L_{10,h}$ in accordance with formula 3.47, which is weighted with the lifetime expectancy factor a_1 on the basis of Table 3.4 and the lifetime coefficient a_{ISO}.

Determination of the life cycle coefficient a_{ISO}

The life cycle coefficient a_{ISO} is read after determining the parameters $e_c \cdot P_u / P_{ma}$ and κ from diagram 3.3 or else calculated on the basis of equations 3.55 to 3.57.

$$a_{ISO} = f\left(\frac{e_c \cdot P_{ua}}{P_{ma}}, \kappa\right) \quad [3.49]$$

e_c	contamination coefficient (Table 3.6)	
P_{ua}	fatigue limit load axial/radial	[N]
P_{ma}	medium dyn. equiv. load, axial	[N]
κ	viscosity ratio	

Fatigue limit load P_{ua}

The fatigue limit load P_{ua} takes into consideration the fatigue limit of the raceway material. According to DIN ISO 281, this yields the following values for the fatigue limit load:

$$P_{ua} \cong C_{oa}/27 \quad \text{Ball bearing} \quad [N] \quad [3.50]$$

C_{oa}	static axial load rating	[N]

IBC supplies precision 60° ball screw support bearings and units that have been given a filling of a clean special grease at the factory. In a few cases the end user handles the greasing himself or else uses a form of oil lubrication. The following shows how the lifetime is limited due to impurities brought in during mounting or operation.

Contamination coefficient e_c

Hard and solid impurities in the lubricant can cause lasting impressions in the raceways during the rolling contact. The local stress set-ups that are caused as a result reduce the lifetime of the high-precision rolling bearings. The reduction in lifetime due to solid particles depends on the size of the bearing. The thickness of the lubricating film (depending on the viscosity ratio κ) and the size, type, hardness and quantity of the dirt particles. Other forms of contamination, such as the entry of liquids is not taken into consideration when looking at the lifetime, but can lead to a further change in the lifetime.

In the event of severe contamination ($e_c \rightarrow 0$) then failures are probable before the calculated lifetime has been reached. Table 3.6 refers for the impurity to be determined:

Degree of contamination	Coefficient e_c D_{pw} < 100 mm	D_{pw} > 100 mm
Extreme Cleanliness Particle size and lubricating film thickness, laboratory conditions	1	1
High level of cleanliness Extra-fine filtering of the oil fed in sealed, greased bearings	0.8...0.6	0.9...0.8
Normal cleanliness Fine filtering of the oil fed in greased bearings with shield	0.6...0.5	0.8...0.6
Minor contamination Minor contamination in oil supply	0.5...0.3	0.6...0.4
Moderate contamination Bearings contaminated with erosion from other machine elements	0.3...0.1	0.4...0.2
Severe contamination Severely contaminated bearing environment, inadequate sealing	0.1...0	0.1...0
Very severe contamination	0	0

Table 3.6: Contamination coefficient e_c depending on the reference diameter D_{pw} of the rolling bearing

The special greases used for 60° ball screw support bearings exhibit the following viscosities (other grease fillings on request):

Grade of grease	Basic oil viscosity [mm²/s] 40 °C	100 °C
BEARLUB GH62	150	18
BEARLUB GN21	82	12.5

Table 3.7: Viscosities of IBC special greases

Viscosity ratio κ

κ serves as an indication of the quality of the formation of the lubricating film. It is the ratio of the lubricant viscosity ν at the operating temperature to the reference viscosity ν_1. The separating lubricating film is just attained with κ = 1. In order to determine κ, first of all the reference viscosity ν_1 from diagram 3.1 is determined according to the reference diameter D_{pw} and the speed of rotation n.

The operating viscosity ν is then read off from the viscosity-temperature diagram 3.2 at the intersection of the expected operating temperature t with the diagonally running graphs of the reference viscosities related to 40 °C.

The ratio κ is determined from this:

$$\kappa = \frac{\nu}{\nu_1} \qquad [3.51]$$

κ	viscosity ratio	
ν	operating viscosity	[mm²/s]
ν_1	reference viscosity	[mm²/s]

The viscosity ratio κ in accordance with formula 3.51 is to be determined from diagrams 3.1 and 3.2 or else can be determined by calculation. The following applies for the reference viscosity ν_1:

$$\nu_1 = 45.000 \cdot n^{-0,83} \cdot D^{-0,5} \quad \text{for } n < 1.000 \text{ rpm} \qquad [3.52]$$

$$\nu_1 = 4.500 \cdot n^{-0,5} \cdot D_{pw}^{-0,5} \quad \text{for } n > 1.000 \text{ rpm} \qquad [3.53]$$

D_{pw} Reference diameter of the precision rolling bearing $= d_m = (d + D)/2$ [mm]

The following formula is applied for lubricants with a density differing from the reference density ρ_1 = 0,89 g/cm³ at 20 °C:

$$\kappa = \frac{\nu}{\nu_1} \cdot \left(\frac{\rho}{\rho_1}\right)^{0,83} \qquad [3.54]$$

ρ	density of the lubricant used	[g/cm³]
ρ_1	reference density	[g/cm³]

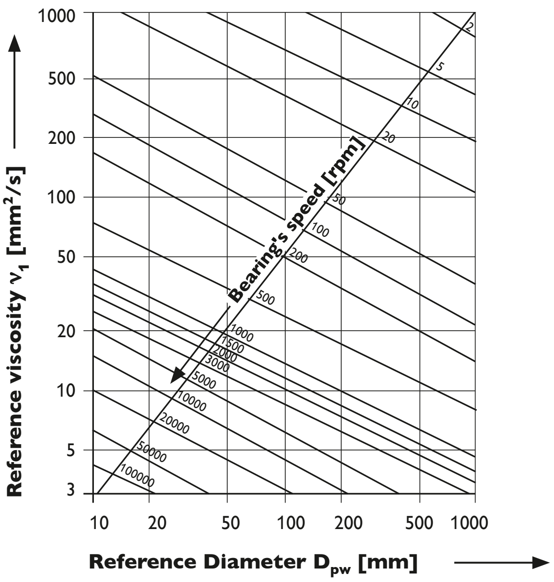


Diagram 3. 1: Required reference viscosity ν_1

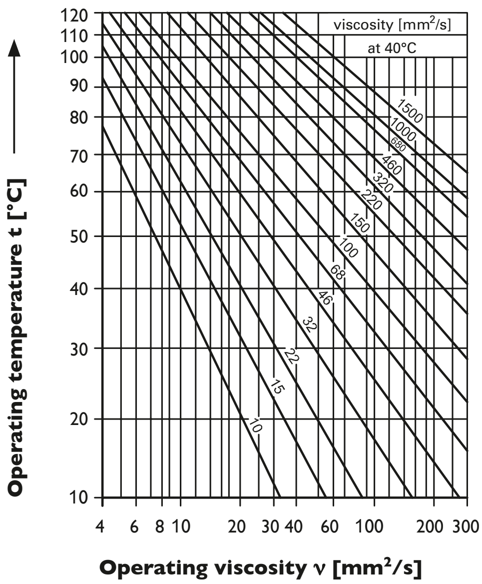


Diagram 3.2: Operating viscosity ν for mineral oils

For a viscosity ratio $\kappa < 1$ and a contamination coefficient $e_c > 0.2$ it is possible to calculate on the basis of the value $\kappa = 1$ when using a lubricant with effective EP additives. However, then the life cycle coefficient is to be limited to $a_{ISO} < 3$. In the event of severe contamination ($e_c < 0.2$) the effectiveness of the additives used must be demonstrated.

The following illustrates the graphic and calculated determination of the life cycle coefficient a_{ISO} for IBC precision 60° ball screw support bearings.

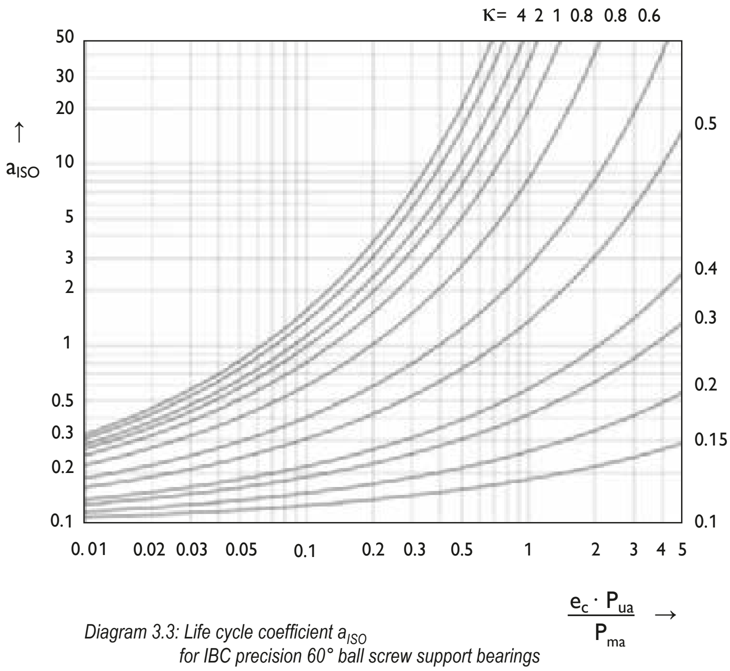


Diagram 3.3: Life cycle coefficient a_{ISO} for IBC precision 60° ball screw support bearings

Calculation of the life cycle coefficient a_{ISO} for IBC precision 60° ball screw support bearings

$$a_{ISO} = 0.1 \cdot \left[1 - \left(2.56705 - \frac{2.26492}{\kappa^{0.0543806}}\right)^{0.83} \cdot \left(\frac{e_c \cdot C_u}{3 \cdot P}\right)^{\frac{1}{3}}\right]^{-9.3} \quad \text{for } 0.1 \le \kappa < 0.4 \quad [3.55]$$

$$a_{ISO} = 0.1 \cdot \left[1 - \left(2.56705 - \frac{1.99866}{\kappa^{0.190870}}\right)^{0.83} \cdot \left(\frac{e_c \cdot C_u}{3 \cdot P}\right)^{\frac{1}{3}}\right]^{-9.3} \quad \text{for } 0.4 \le \kappa < 1 \quad [3.56]$$

$$a_{ISO} = 0.1 \cdot \left[1 - \left(2.56705 - \frac{1{,}99866}{\kappa^{0.0717391}}\right)^{0.83} \cdot \left(\frac{e_c \cdot C_u}{3 \cdot P}\right)^{\frac{1}{3}}\right]^{-9.3} \quad \text{for } 1 \le \kappa < 4 \quad [3.57]$$

Fig. 3.2: Double-row IBC precision 60° ball screw support bearings of the BSD and BSDF series, in two sizes in each case

IBC-special factors

There are lifetime-extending IBC-specific factors concerning the extended lifetime calculation in accordance with DIN ISO 281 which can be applied when using special materials and coatings.

The lifetime-extending properties of the **ATCoat coating** are taken into consideration with factor a_{Ib}. IBC recommends this coating for applications in which very slow movements occur, only limited swivelling movements are made or in other special usage situations.

Factor a_{wk} takes into consideration the significantly longer working life of ceramic rolling elements. This is illustrated in the following.

IBC-specific factors that prolong the lifetime

Raceway material	a_{Ib}	Rolling bearing material	a_{wk}
uncoated	1.00	100Cr6	1.00
IR ATCoat	1.25	Si_3N_4	2.00
AR ATCoat	1.20		
IR & AR ATCoat	1.50		

Table 3.8: IBC-specific factors that prolong the lifetime

The IBC-specific factors are applied to the calculation of the extended lifetime in multiplicative fashion:

$$L_{10,h,\,erw.,\,IBC} = a_{Ib} \cdot a_{wk} \cdot L_{10,nm} \qquad [h] \quad [3.58]$$

$L_{10,h,\,erw.,\,IBC}$	specific modified lifetime IBC	[h]
a_{Ib}, a_{wk}	material-related factors	
$L_{10,nm}$	extended modified lifetime	[h]

The lifetime of the grease should be set using the modified lifetime that has been adjusted in this way on the basis of the IBC-specific factors to determine the possibility of using permanent lubrication or to develop strategies for continuous or cyclical lubrication.

Fig. 3.3 ATCoat-coated precision 60° axial ball screw bearing

Lifetime of the bearing units $L_{10,h\ unit}$

In order to take into account the statistical probability of failure of multiple precision rolling bearings in assemblies, the lifetime of bearing units must be reduced with respect to the lifetime of individual bearings. This is done in accordance with formula 3.59.

$$L_{10,h\ unit} = \frac{1}{\left(\dfrac{i_{(A)}}{L_{10,h\ (A)}^{1.11}} + \dfrac{i_{(B)}}{L_{10,h\ (B)}^{1.11}}\right)^{0,9}} \qquad [h] \quad [3.59]$$

$L_{10,\,h\ unit}$	Lifetime for the bearing unit	[h]
$i_{(A)}$	Number of bearings in the same direction, bearing position A	
$i_{(B)}$	Number of bearings in the oposite direction, bearing position B	[h]
$L_{10,h\ (A)}$	Lifetime for bearing A	[h]
$L_{10,h\ (B)}$	Lifetime for bearing B	

Comments on the lifetime of bearing units

Rolling bearings with normal tolerances have slightly differing bore and outer diameters and hence uneven load proportions as bearing units. However, the precision rolling bearings listed in this catalogue are manufactured to closer tolerances in accordance with P4A or P2H and thus assure even load bearing characteristics.

3.2 Axial stiffness and unloading factors

Precision rolling bearings should not be used without preloading so as to prevent uneven wear of the rolling bearings. Even a minimal amount of preloading prevents the occurrence of an unloaded area in the rolling bearing in which to some extent the rolling elements slide instead of rolling.

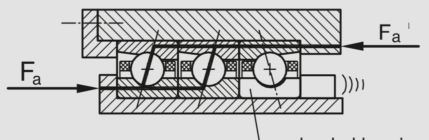
In the case of precision 60° ball screw support bearings in an O-arrangement (DB) the rolling bearing facing away from the load gradually loses its preload when the outer axial load is increased. The rolling bearing no longer has any preload above an outer axial load that is more than three times the preloading load. The rolling elements begin to slide in this rolling bearing as the axial load increases. This unloading of the preload acts on the rolling bearings facing the load in the case of the seldom used X-arrangement (DF).

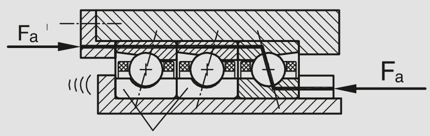
In the more frequently used O-arrangement of the rolling bearings the preloading-unloading factors X and the axial stiffness factors K_a are listed for both load directions. There is a varying axial stiffness for bearing arrangements with a different number of bearings for each direction.

The constants of bearing arrangement K_{Fv} for the determination of the tightening torque for locknuts can be found in Table 3.9. Note here that K_{Fv} does not take into account any interference fits.

Friction torque

The frictional torque M_R (to be taken from the data tables for the individual precision rolling bearings) is increased in the case of bearing sets by twice factor K_{Fv}. For example, for the duplex set in an O-arrangement twice the value of the individual bearing is to be used, for the triple set <<> 2 · 1.36 times the value and for the quadruplex set <<>> by 2 · 2 times equals 4 times the value.





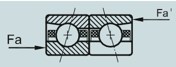
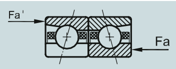
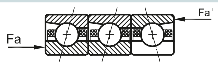
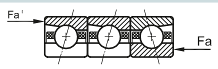
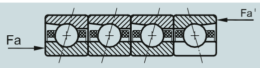
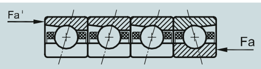
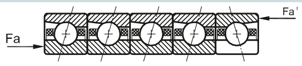
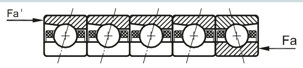
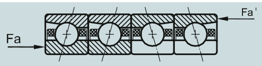
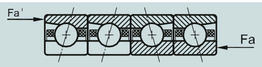
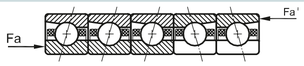
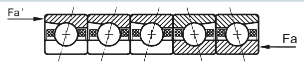
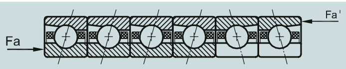
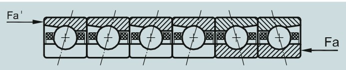
Load in main direction Face A B	axial stiffness factor K_a	unloading from $X \cdot F_v$	Load direction reversed Face A B	axial stiffness factor K_a	unloading from $X \cdot F_v$	Constant of the bearing arrangement K_{Fv}
	1.00	2.83		1.00	2.83	1.00
	1.63	5.66		1.30	2.83	1.36
	2.22	8.49		1.54	2.83	1.57
	2.80	11.3		1.76	2.83	1.71
	2.00	5.66		2.00	5.66	2.00
	2.64	8.49		2.31	5.66	2.42
	3.26	11.3		2.59	5.66	2.72

Table 3.9: Comparison of the axial stiffness for rolling bearing sets of the same type for various loads

3.3 Criteria for bearing arrangements for ball screws

Influence of the bearing arrangement to the critical speed of rotation, security of the spindle against buckling, and spindle stiffness

The selection of precision rolling bearings and their arrangement on the spindle of a ball screw have an influence on the critical rotational speed for bending, buckling behaviour and the overall stiffness of the spindle.

Critical speed of rotation n_{kr}

The critical speed of rotation of the 1st order n_{kr}, above which the spindle bulges due to the natural frequency, depends on the spindle core diameter d_{core}, of the unsupported, free spindle length l_f and the bearing arrangement. It is ensured through the factor 0,8 that the permissible operating speed of rotation n_{perm} is below the critical speed of rotation n_{kr}. The core diameter d_{core} of the ball screw can be determined approximately through formula 3.60 or else requested from the manufacturer of the ball screw.

$d_{core} = d_o - d_{wKGT}$	[mm]	[3.60]
$n_{kr} = k_a \cdot d_{core} \cdot 10^6 / l_f^{\,2}$	[rpm]	[3.61]
$n_{perm} = 0.8 \cdot n_{kr}$	[rpm]	[3.62]

d_{core}	core diameter of the ball screw	[mm]
d_o	nominal diameter of the ball screw	[mm]
d_{wKGT}	ball diameter of the ball screw	[mm]
l_f	unsupported free spindle length	[mm]
n_{kr}	critical speed of rotation 1st order	[rpm]
n_{perm}	permissible operating speed for rotation	[rpm]
k_a	constant for the arrangement for directionally-stable clamping	

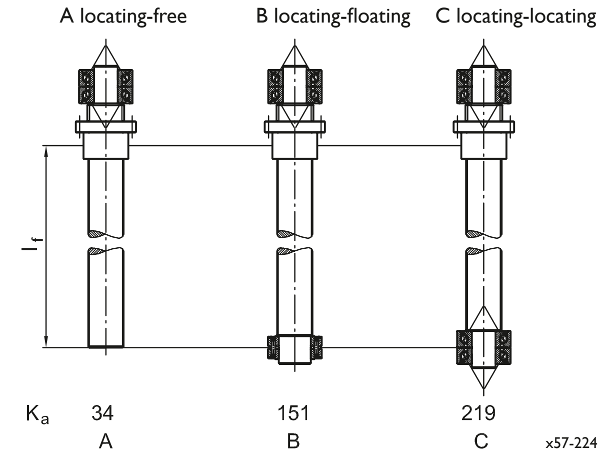


Bild 3.4: Constant of the arrangement k_a for various forms of directionally-stable clamping

The speed of rotation can be determined as follows from the movement speed:

$n = 1.000 \cdot v/p$	[rpm]	[3.63]

n	speed of rotation	[rpm]
v	movement speed	[m/min]
p	pitch	[mm]

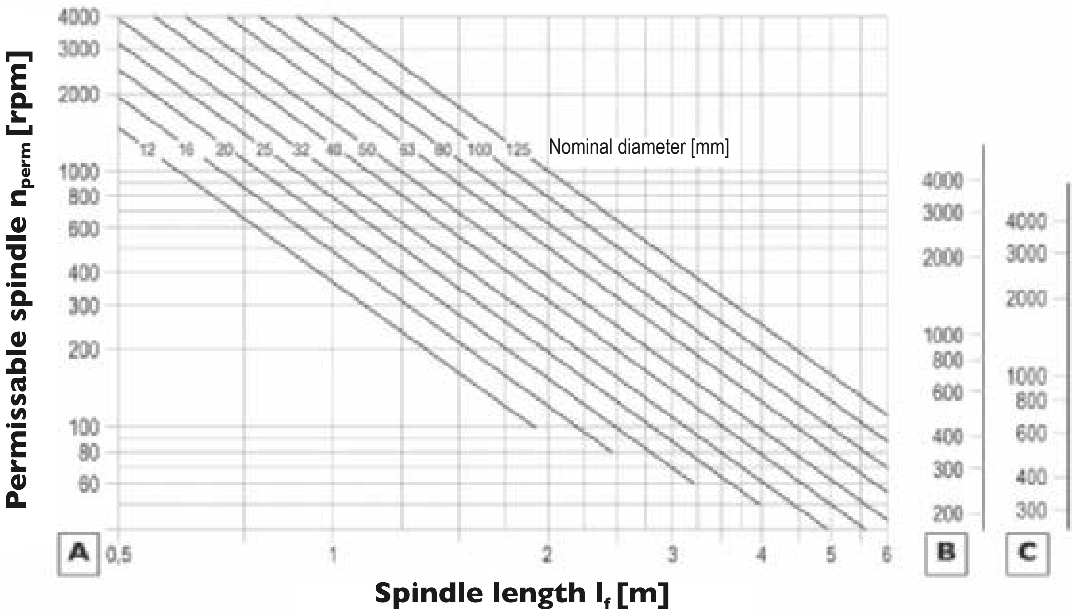


Diagram 3.4: Permissible spindle rpm depending on the spindle length, the nominal diameter and the bearings (in accordance with Fig. 3.4) (The safety factor 0.8 is included in the diagram)

Sagging

Horizontally-arranged ball screws with a high length-to-diameter ratio l_f/d_0 > 50 should be checked for any impermissible spindle sagging in order to set a floating bearing at the end if required. A support may be required for long spindles clamped on both sides. This also applies to the driven nuts of ball screws above a ratio of l_f/d_0 > 40.

Buckling

Very long, slender spindles must be checked for buckling. The permissible buckling load F_k can be increased by the bearing arrangement in accordance with case B or C or by using a larger spindle diameter.

$$F_k = \pi^2 \cdot E \cdot I / l_k^2 \qquad [N] \quad [3.64]$$

Minimum moment of the inertia of the spindle:

$$I = \pi \cdot d_{core}^4 / 64 \qquad [mm^4] \quad [3.65]$$

F_k	max. permissible buckling load as per Euler		[N]
E	Young's modulus (for steel 210,000)		[N/mm²]
I	minimum moment of inertia of the spindle		[mm⁴]
l_k	effective buckling length		
	Case A: clamped on one side	$l_k = 2\ l_f$	
	Case B: locating-floating	$l_k = 0.7\ l_f$	
	Case C: locating-locating	$l_k = 0.5\ l_f$	
l_f	unsupported spindle length		[mm]

Total stiffness of a ball screw bearing arrangement

The axial stiffness of a ball screw K_{aKGT} primarily depends, and also mostly in this order, on the stiffness of the ball screw K_{aS}, the stiffness of the ball screw nut K_{aM} and the stiffness of the bearings K_{aL} (usually the cast bed can be ignored here).

$$\frac{1}{K_{aKGT}} = \frac{1}{K_{aS}} + \frac{1}{K_{aM}} + \frac{1}{K_{aL}} \qquad [N/\mu m] \quad [3.66]$$

K_{aKGT}	total stiffness	[N/µm]
K_{aS}	stiffness of the spindle	[N/µm]
K_{aM}	stiffness of the BS nut	[N/µm]
K_{aL}	stiffness of the bearings	[N/µm]

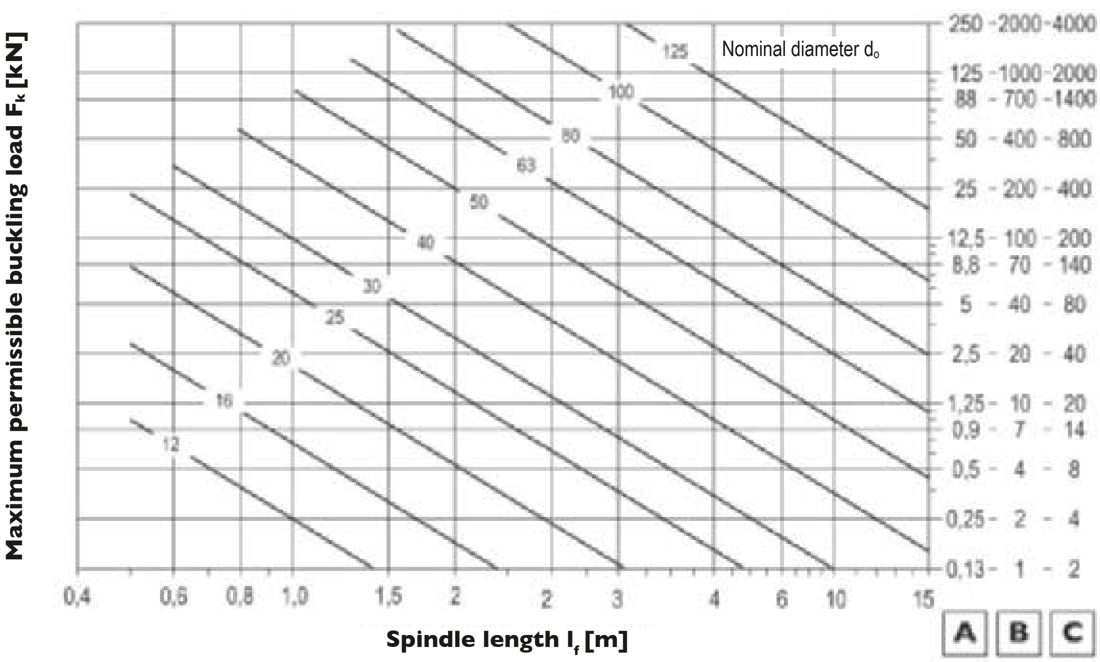


Diagram 3.5: Maximum permissible buckling load F_k depending on the nominal diameter, the unsupported buckling length l_f and the bearings (according to Fig. 3.4)

The various types of clamping determine the stiffness of the spindle. A distinction is made here between the following types of clamping:

Fixed clamping on one side - opposing side free of floating

$$K_{as} = \frac{A \cdot E}{l \cdot 10^3} \quad [N/µm] \quad [3.67]$$

A	spindle core diameter	[mm²]
l	distance of the ball screw nut/bearing	[mm]
E	Young's modulus (for steel 210,000)	[N/mm²]

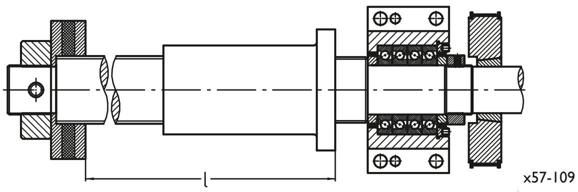


Fig. 3.5: Ball screw with fixed clamping - opposing side free

Fixed clamping on both sides

$$K_{as} = \frac{4 \cdot A \cdot E}{l \cdot 10^3} \quad [N/µm] \quad [3.68]$$

Illustration of the spindle bearings in a driven spindle

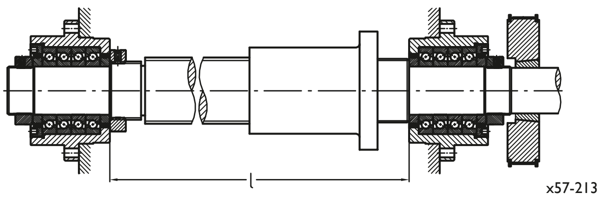


Fig. 3.6: Ball screw with fixed clamping on both sides

Pretensioning of spindles

A change in length due to warming up of the spindle also means an increase in the pitch p and hence the inaccuracy of the entire system. If this change in length is to a manageable level, this is ground in within the spindle and the deviation from the nominal pitch due to the warming up of the spindle is compensated for in the subsequent change in length.

Alternatively, the spindle can also be stretch formed to increase the stiffness. The pretensioning forces that occur as a result must be taken up by the rolling bearings in the case of driven spindles. The rolling bearings are free of the pretensioning forces in driven nuts.

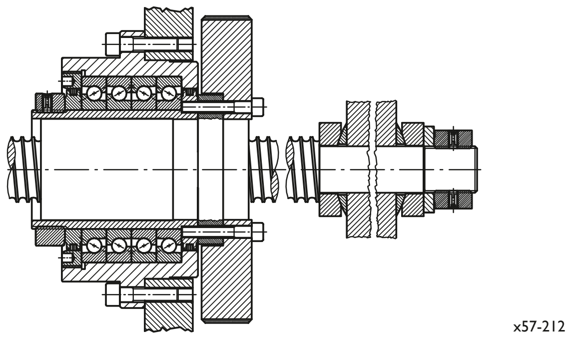


Fig. 3.7: Ball screw with driven nut and fixed pretensioned spindle

$$\Delta_l = \alpha \cdot l \cdot \Delta_t \quad [mm] \quad [3.69]$$

Δ_l	longitudinal stretching of the spindle	[mm]
α	coefficient of the expansion for steel: $11.7 \cdot 10^{-6}$	[K⁻¹]
Δ_t	temperature differential	[K]
l	total length between the bearings	[mm]

Pretensioning force required:

$$F_{reck} = \Delta_l \cdot E \cdot A / l \quad [N] \quad [3.70]$$

F_{reck}	required stretch forming force	[N]
A	Spindle core cross section	[mm²]

The stretch forming of spindles is usually for an anticipated warming up of 2 Kelvin. Any warming up of the spindle beyond this amount is to be avoided if at all possible, since excessively high forces would act on the bearings in such cases. There are the following possibilities:

- use of spring-preloaded bearing units (see page 94).
- selection of a greater pitch for the ball screw with an associated reduction in the speed of rotation.
- use of ceramic rolling elements. These can be enquired with the prefix CB.

3.4 Bearing combinations for longer spindles - selection criteria

Selection criteria for bearings for longer spindles

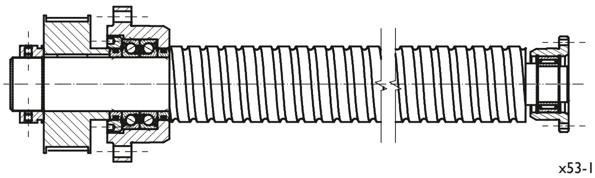
While the bearings of short spindles can be illustrated relatively simply in view of the wide range of IBC products for bearing units that are easy to install, additional criteria need to be taken into consideration for longer spindles.

There are various solutions available from the IBC range to support longer spindles.

Driven ball screw spindles

1. Combination of locating-floating bearing units

a) with precision flange unit BLBU

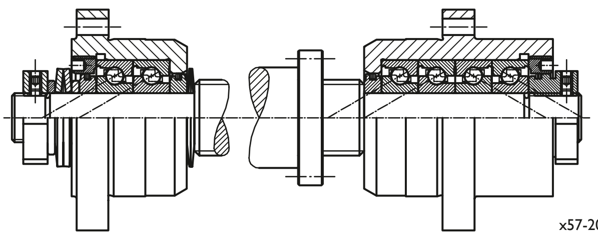


x53-105

b) with precision pillow block unit BLPB

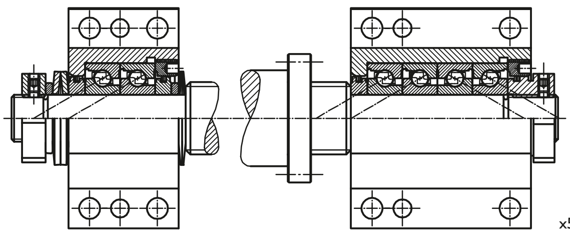
2. Combination of locating and spring-preloaded flange or pillow block units

a) using spring-preloaded precision flange unit BSBU..DB..DT+PLS the spindle is pretensioned



x57-206

or else this is done with a spring-preloaded precision pillow block assembly BSPB..D..DT+PLS.



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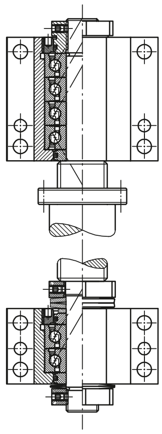
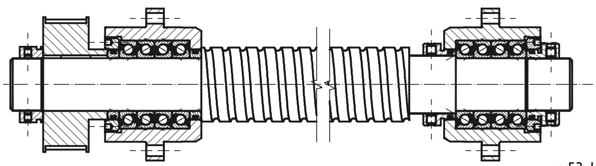
The pretensioning of the spindle raises the critical speed of rotation of the spindle.



x57-237

b) Using the lower spring-preloaded unit, in a vertical installed position the load of the ball screw spindle is taken up additionally, BS..D..DT-B+PLS (see page 95).

3. Locating-locating bearing arrangement



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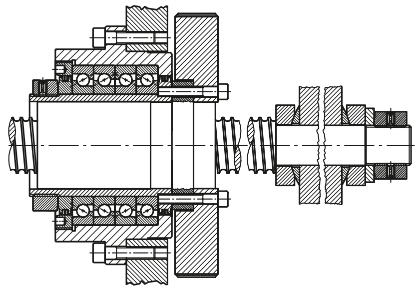
Driven ball screw nuts

1. Precision adapter flange units

a) BNBU series



x57-212

b) BNBUS series with integrated lubrication system for the ball screw nut

c) as for a) or b) with an adapter sleeve with optimized connecting flange

2. Precision adapter pillow block units

a) BNPB series

b) BNPBS series with integrated lubrication system for the ball screw nut

c) as for a) or b) with an adapter sleeve with optimized connecting flange

3. Precision 60° ball screw support bearings integrated into a special motor

4. IBC precision 60° ball screw support bearings

4.1 IBC precision 60° ball screw support bearings, single-row

Single-row IBC precision 60° ball screw support bearings can accept combined loads but primarily in an axial direction. The large contact angle permits high axial loadings with very high axial stiffness. The radial loading should not exceed 90 % of the preload. Since axial one-sided acting precision 60° ball screw support bearings can only take up axial loads in one direction, they must always be set up against a second set of precision 60° ball screw support bearings or used as a floating bearing against a spring or a spring package.

Arrangements

As a rule, precision 60° ball screw support bearings are used as a duplex, triplex, quadruplex or pentaplex set for the bearings of ball screws in feed units.

Precision 60° ball screw support bearings are supplied individually as universal bearings or as made-up bearing sets, mostly with an O-arrangement. They can also be used in other arrangements (see below). Further arrangements are possible as required. In addition to the arrow marking of the individual bearing, bearing sets have an overall V-marking that indicates the direction of the axial main load (see Fig. 4.1).

Tolerances

Precision 60° ball screw support bearings are supplied in precision classes P4A and P2H. This gives the tolerances for the bore and outer diameters in accordance with tolerance class P4 and for the runout in accordance with tolerance class P2 (see Table 4.1, page 35). When ordering sets, precision 60° ball screw support bearings are put together and supplied in such a way that the tolerance zone for the bore and outer diameter is only half or less.

Preloading

IBC precision 60° ball screw support bearings with light, medium and heavy preload are very well suited for mounting in sets, since the preload has been universally ground in. We recommend IBC precision locknuts of the MMRB and MMRS series (see pages 78 and 84) for the preloading. Close fits lead to an increase in the preload and should be avoided. Recommendations concerning fits are listed on page 35.

Rolling bearing rings and rolling elements

Rolling bearing rings and rolling elements are made of vacuum· degassed, fine-grain rolling bearing steel 100Cr6 (1.3505).

Optional special rolling bearing materials and coatings

- CB- Rolling elements made of Si_3N_4 ceramic to increase the speed by 35 %
- AC- Outer and inner rings coated with ATCoat
- ACC- Outer and inner rings coated with ATCoat and rolling elements made of Si_3N_4 ceramic

Cage

The ball-guided cages are made of glassfibre-reinforced polyamide material.

Lubrication

By default the bearings are supplied pre-filled with the proven IBC grease BEARLUB GH62. Alternatively, medium- and low· viscosity greases can be used for higher rotational speeds. Alternatively, IBC also produces rolling bearings with an oil lubrication groove and holes.

Sealing

Precision 60° ball screw support bearings are usually supplied open and combined in a housing with labyrinth seals of the S series, see page 82.

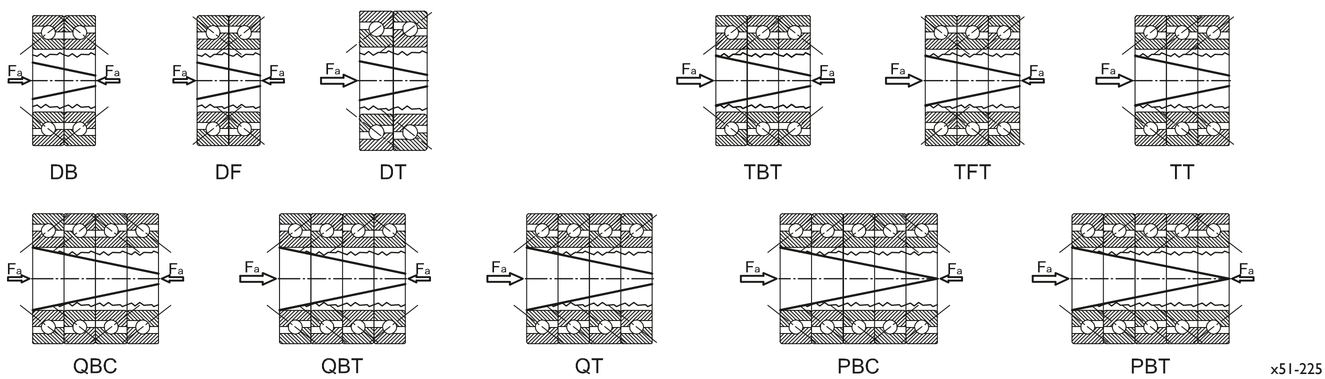


Fig. 4.1: Possible combinations of bearing arrangements made up of individual bearings to create duplex, triplex, quadruplex and pentaplex sets; the arrows show the possible loading

4.1.1 Designation system

Examples:

CB	BS	75 M	110			.P4A	.D	UM		.OX
	BS	30 M	62	/16	.2RSZ	.P4A.		UH		.GN21G
AC-	BS	50 M	100			.P4A	.Q	UM	.A15	.GH62G
	BSB	80 M	170			.P5A	.D	UM		

Material

-	rolling elements and rings 100Cr6
CB	rolling elements Si_3N_4
AC-	rings ATCoat
ACC-	rings ATCoat + rolling elements Si_3N_4

Design

BS	60° contact angle
BSB	40° contact angle

Bore diameter and dimension units

25M	metric dimensions d = 25 mm
150I	imperial (inch) measurements d = 1.50“ (38.1 mm)

Bearing outside diameter

only for metric rolling bearings in mm

Bearing width

-	standard width
/17	width according with DIN 616 in mm

Seal

-	open rolling bearing
ARSZ	low-friction seal at the high shoulder of the outer ring
BRSZ	low-friction seal at the low shoulder of the outer ring
2RSZ	low-friction seal on both sides
2RZ	gap seal on both sides
2RS	contact seal on both sides

Lubrication

-	50% / GH62 (standard)
GN21G	30 - 35% / GN21
OX	only corrosion protected

ATCoat coating

-	no coating
A11	inner and outer ring coated
A11L	inner and outer ring raceway coated
A11LF	inner and outer ring raceway coated and finished
A15	inner and outer ring coated rolling elements and cage
A21	inner ring coated
A31	outer ring coated
A31M	outer ring outer diameter coated

Preload and axial bearing clearance

UL	light
UM	medium
UH	high
U...	special preloading, specifications in daN
A...	axial bearing clearance, specifications in µm
U	universally ground

Angular contact ball bearing sets

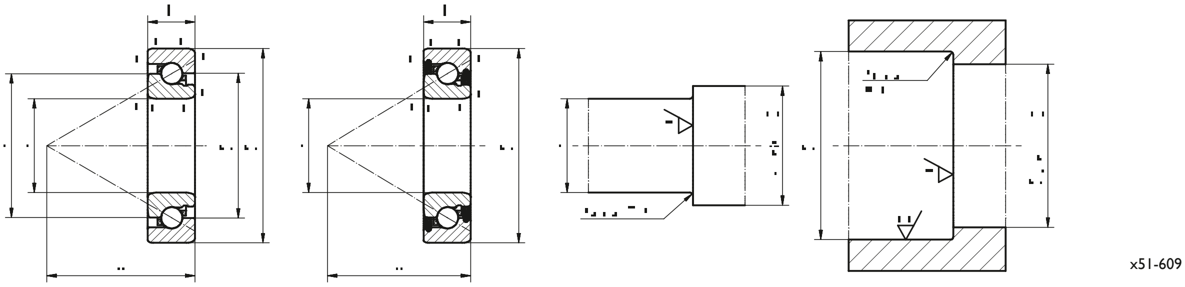
D...	duplex set
T...	triplex set
Q...	quadruplex set
P...	pentaplex set

Accuracy

P5A*
P4
P4A
P2H

** Tolerance details P5A for BSB bearings on request.*

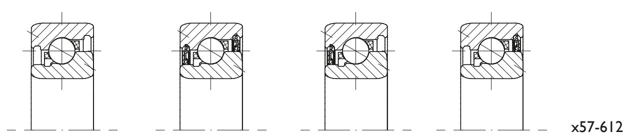
4.1.2 Principal dimensions



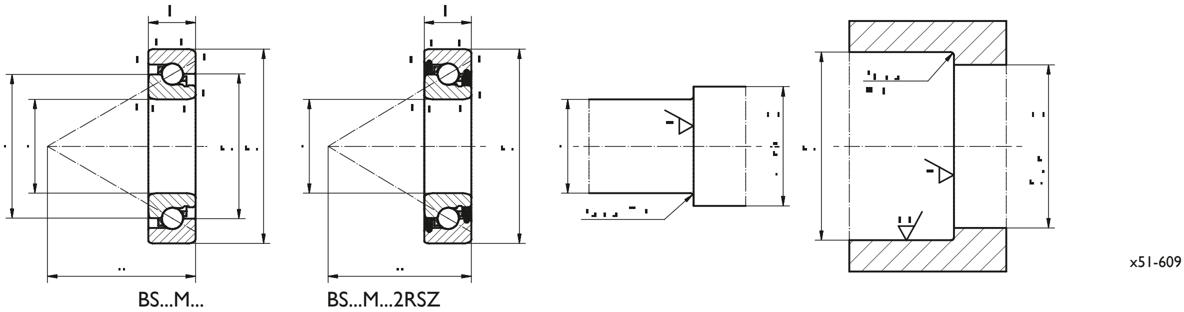
BS...M... BS...M...2RSZ

Basic Dimensions d	D	B	Basic designation	Load ratings C_a	C_{oa}	Fatigue limit load C_u	Effective load centre a	Mounting dimensions $r_{1,2\,min}$	$r_{3,4\,min}$	$d_{a\,min}$	d_1	D_1	$D_{b\,max}$	Weight m
mm				N		N		mm						kg
15	47	15	BS 15M47	25,200	33,800	1,250	36.5	0.6	0.6	26	33.4	34.1	40	0.13
17	47	15	BS 17M47	25,200	33,800	1,250	36.5	0.6	0.6	26	33.4	34.1	40	0.13
20	47	14	BS 20M47/14	25,200	33,800	1,250	36	0.6	0.6	28	33.4	34.1	40	0.14
20	47	15	BS 20M47	25,200	33,800	1,250	36.5	0.6	0.6	28	33.4	34.1	40	0.15
20	52	15	BS 20M52	26,800	39,400	1,460	39	1.0	0.6	32	38.2	38.9	45	0.17
25	52	15	BS 25M52	26,800	39,400	1,460	39	1.0	0.6	34	38.2	38.9	45	0.15
25	62	15	BS 25M62	30,400	49,800	1,840	46.5	1.0	0.6	34	45.8	46.2	54	0.25
25	62	17	BS 25M62/17	30,400	49,800	1,840	47.5	1.0	0.6	34	45.8	46.2	54	0.28
30	62	15	BS 30M62	30,400	49,800	1,840	46	1.0	0.6	38	45.8	46.2	54	0.22
30	62	16	BS 30M62/16	30,400	49,800	1,840	47	1.0	0.6	38	45.8	46.2	54	0.23
30	72	15	BS 30M72	32,900	62,100	2,300	56	1.0	0.6	39	55.0	58.0	64	0.32
30	72	19	BS 30M72/19	32,900	62,100	2,300	58	1,0	0.6	39	55.0	58.0	64	0.41
35	72	15	BS 35M72	32,900	62,100	2,300	56	1.0	0.6	43	55.0	58.0	64	0.29
35	72	17	BS 35M72/17	32,900	62,100	2,300	57	1.0	0.6	43	55.0	58.0	64	0.34
35	100	20	BS 35M100	67,900	133,000	4,930	75	1.0	0.6	47	74.5	75.5	89	1.05
40	72	15	BS 40M72	32,900	62,100	2,300	56	1.0	0.6	48	55.0	58.0	64	0.28
40	80	18	BS 40M80/18	46,000	81,200	3,010	61	1.0	0.6	48	60.5	61.5	64	0.42
40	90	20	BS 40M90	58,100	113,800	4,210	71.5	1.0	0.6	49	69.0	71.0	82	0.64
40	90	23	BS 40M90/23	58,100	113,800	4,210	73	1.0	0.6	49	69.0	71.0	82	0.72
40	100	20	BS 40M100	67,900	133,000	4,930	75	1.0	0.6	49	74.5	75.5	89	1.00
45	75	15	BS 45M75	44,300	85,700	3,170	60	1.0	0.6	53	59.8	60.3	67	0.29
45	100	20	BS 45M100	67,900	133,000	4,930	75	1.0	0.6	54	74.5	75.5	89	0.95
50	90	20	BS 50M90	58,100	113,800	4,210	71.5	1.0	0.6	59	69.0	71.0	82	0.60
50	100	20	BS 50M100	69,200	140,000	5,190	75	1.0	0.6	59	78.0	79.0	89	0.89
55	90	15	BS 55M90	47,900	105,600	3,910	73	1.0	0.6	64	72.0	73.0	81	0.42
55	100	20	BS 55M100	69,200	140,000	5,190	75	1.0	0.6	65	78.0	79.0	89	0.71
55	120	20	BS 55M120	86,200	191,400	7,090	88	1.0	0.6	65	90.5	94.0	108	1.43
60	110	22	BS 60M110	71,500	140,300	5,200	85	1.0	0.6	65	84.5	87.5	108	0.94
60	120	20	BS 60M120	86,200	189,500	7,020	88	1.0	0.6	70	90.5	94.0	108	1.36
75	110	15	BS 75M110	52,000	134,400	4,980	89	1.0	0.6	85	93.2	94.2	100	0.48
80	140	26	BSB 80M140	123,600	181,600	6,730	108	2.0	0.6	85	109.5	112.0	124	1.72
80	170	39	BSB 80M170	189,600	275,400	10,200	129	2.1	1.1	111	124.5	127.0	145	4.50
100	150	22,5	BS 100M150	102,100	275,800	10,210	118	1.0	0.6	114	124.9	125.3	137	1.00
100	215	47	BSB 100M215	167,400	309,400	11,460	161	3.0	1.1	140	162.0	163.0	180	8.80
120	260	55	BSB 120M260	334,200	611,400	22,640	192	3.0	1.1	150	197.0	203.0	228	14.90
127	180	22.225	BS 127M180	111,100	340,400	12,610	143	1.0	0.6	140	155.5	156.6	168	1.24
20	47	15.875	BS 078I	25,200	33,800	1,250	38	1.0	0.6	28	33.4	34.1	40	0.14
23.838	62	15.875	BS 093I	30,400	49,800	1,840	50	1.0	0.6	32	45.8	46.6	54	0.25
38.100	72	15.875	BS 150I	32,900	62,100	2,300	56	1.0	0.6	46	55.0	55.7	64	0.28
44.475	76.2	15.875	BS 175I	44,300	85,700	3,170	60	1.0	0.6	52	59.8	60.5	68	0.30
57.150	90	15.875	BS 225I	47,900	105,600	3,910	73	1.0	0.6	64	72.3	73.2	81	0.38

Up to D =100 mm also available with seals on both sides; suffix 2RSZ
ARSZ (seal at the high shoulder of the outer ring)
BRSZ (seal at the low shoulder of the outer ring)



2RSZ ARSZ BRSZ



Basic Dimensions			Basic designation	Preload F_V			Axial Stiffness S_{ax}*			Speed-Grease n_F**			Frictional torque M_R***		
d	D	B		L	M	H	L	M	H	L	M	H	L	M	H
	mm				N			N/µm			rpm			Nm	
15	47	15	BS 15M47	850	1,910	3,820	530	710	900	11,100	8,900	4,500	0.03	0.05	0.09
17	47	15	BS 17M47	850	1,910	3,820	530	710	900	11,100	8,900	4,500	0.03	0.05	0.09
20	47	14	BS 20M47/14	850	1,910	3,820	530	710	900	11,100	8,900	4,500	0.03	0.05	0.09
20	47	15	BS 20M47	850	1,910	3,820	530	710	900	11,100	8,900	4,500	0.03	0.05	0.09
20	52	15	BS 20M52	990	2,230	4,460	600	790	1,010	9,600	7,700	3,900	0.04	0.06	0.12
25	52	15	BS 25M52	990	2,230	4,460	600	790	1,010	9,600	7,700	3,900	0.04	0.06	0.12
25	62	15	BS 25M62	1,250	2,810	5,620	720	950	1,210	8,100	6,500	3,300	0.06	0.09	0.19
25	62	17	BS 25M62/17	1,250	2,810	5,620	720	950	1,210	8,100	6,500	3,300	0.06	0.09	0.19
30	62	15	BS 30M62	1,250	2,810	5,620	720	950	1,210	8,100	6,500	3,300	0.06	0.09	0.19
30	62	16	BS 30M62/16	1,250	2,810	5,620	720	950	1,210	8,100	6,500	3,300	0.06	0.09	0.19
30	72	15	BS 30M72	1,550	3,490	6,980	880	1,160	1,480	6,600	5,300	2,700	0.09	0.14	0.29
30	72	19	BS 30M72/19	1,550	3,490	6,980	880	1,160	1,480	6,600	5,300	2,700	0.09	0.14	0.29
35	72	15	BS 35M72	1,550	3,490	6,980	880	1,160	1,480	6,600	5,300	2,700	0.09	0.14	0.29
35	72	17	BS 35M72/17	1,550	3,490	6,980	880	1,160	1,480	6,600	5,300	2,700	0.09	0.14	0.29
35	100	20	BS 35M100	3,330	7,490	14,980	1,270	1,680	2,140	5,000	4,000	2,000	0.23	0.37	0.73
40	72	15	BS 40M72	1,550	3,490	6,980	880	1,160	1,480	6,600	5,300	2,700	0.09	0.14	0.29
40	80	18	BS 40M80/18	2,030	4,570	9,140	920	1,210	1,550	6,100	4,900	2,500	0.12	0.19	0.39
40	90	20	BS 40M90	2,280	5,130	10,260	1,050	1,390	1,770	5,600	4,500	2,300	0.14	0.22	0.45
40	90	23	BS 40M90/23	2,280	5,130	10,260	1,050	1,390	1,770	5,600	4,500	2,300	0.14	0.22	0.45
40	100	20	BS 40M100	3,330	7,490	14,980	1,270	1,680	2,140	5,000	4,000	2,000	0,23	0.37	0.73
45	75	15	BS 45M75	1,710	3,850	7,700	900	1,190	1,510	6,300	5,000	2,500	0.10	0.16	0.32
45	100	20	BS 45M100	3,330	7,490	14,980	1,270	1,680	2,140	5,000	4,000	2,000	0.23	0.37	0.73
50	90	20	BS 50M90	2,280	5,130	10,260	1.050	1,390	1,770	5,300	4,200	2,100	0.15	0.24	0.48
50	100	20	BS 50M100	2,800	6,300	12,600	1.230	1,630	2,070	4,800	3,800	1,900	0.20	0.33	0.65
55	90	15	BS 55M90	2,110	4,750	9,500	1,090	1,450	1,840	5,100	4,100	2,100	0.15	0.24	0.48
55	100	20	BS 55M100	2,800	6,300	12,600	1,230	1,630	2,070	4,800	3,800	1,900	0.20	0.33	0.65
55	120	20	BS 55M120	3,790	8,530	17,060	1,400	1,850	2,360	4,000	3,200	1,600	0.31	0.50	0.99
60	110	22	BS 60M110	2,810	6,320	12,640	1,150	1,510	1,930	4,400	3,500	1,800	0.23	0.37	0.74
60	120	20	BS 60M120	3,790	8,530	17,060	1,400	1,850	2,360	4,000	3,200	1,600	0.31	0.50	0.99
75	110	15	BS 75M110	2,690	6,050	12,100	1,150	1,530	1,940	4,000	3,200	1,600	0.26	0.41	0.82
80	140	26	BSB 80M140	3,630	8,170	16,340	770	1,030	1,330	3,400	2,700	1,400	0.35	0.56	1.12
80	170	39	BSB 80M170	5,510	12,400	24,800	840	1,120	1,440	3,000	2,400	1,200	0.61	0.98	1.96
100	150	22.5	BS 100M150	5,520	12,420	24,840	1,860	2,460	3,120	3,000	2,400	1,200	0.56	0.89	1.78
100	215	47	BSB 100M215	6,190	13,930	-	1,170	1,570	-	2,300	1,800	-	0.53	0.85	-
120	260	55	BSB 120M260	12,230	27,520	-	1,380	1,840	-	1,900	1,500	-	1.77	2.83	-
127	180	22.225	BS 127M180	6,810	15,320	-	2,430	3,210	-	2,400	1,900	-	0.59	0.94	-
20	47	15.875	BS 078I	850	1,910	3,820	530	710	900	11,100	8,900	4,500	0.03	0.05	0.09
23.838	62	15.875	BS 093I	1,250	2,810	5,620	720	950	1,210	8,100	6,500	3,300	0.06	0.09	0.19
38.100	72	15.875	BS 150I	1,550	3,490	6,980	880	1,160	1,480	6,600	5,300	2,700	0.09	0.14	0.29
44.475	76.2	15.875	BS 175I	1,710	3,850	7,700	900	1,190	1,512	6,300	5,000	2,500	0.10	0.16	0.32
57.150	90	15.875	BS 225I	2,110	4,750	9,500	1,090	1,450	1,840	5,100	4,100	2,100	0.15	0.24	0.49

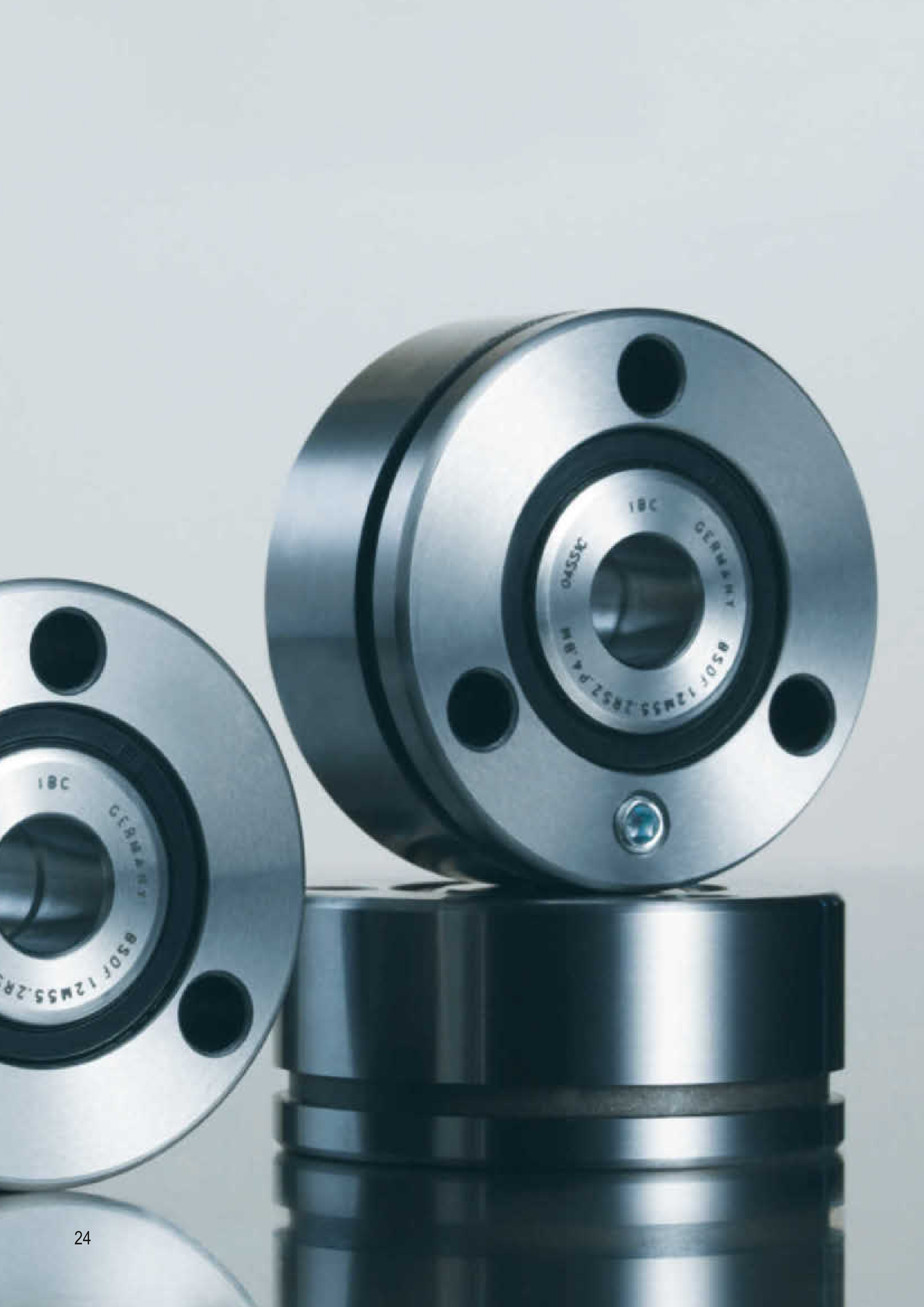
** For a bearing pair in O- or X-arrangement. For multiple arrangements see page 14, Table 3.9: Factor K_a*

*** The specified values apply for individual bearings in a standard configuration. Regarding the operating speed of rotation of the set or the special configuration, the speeds of rotation should be multiplied by the following factors:*

<>	*0-, DB arrangement 0.8*	<<>	*TBT arrangement 0.65*	<<<>	*QBT arrangement 0.6*	<<<<>	*PBT arrangement 0.45*
><	*X-, DF arrangement 0.7*			<<>>	*QBC arrangement 0.55*	<<<>>	*PBC arrangement 0.35*

When greased with GN21 x 1. 05 *with ceramic balls CB x 1.35*

**** Values for individual bearings; for multiple arrangements see page 14, Table 3.9*


IBC
GERMANY

4.2 IBC precison 60° ball screw support bearings, double-row

4.2.1 Designation system

Examples:

CB	BSD	30M	62	.2RSZ	.P4	.BM		
	BSD	30MS	72	.2RSZ	.P4	.BM		
	BSDFA	10M	32	.2RSZ	.P4	.BM		
AC-	BSDF	30MS	100	.2RZ	.P4	.DBM-2	.A11	.GN21G

Material

-	rolling elements 100Cr6
CB	rolling elements Si_3N_4
AC-	rings ATCoat
ACC-	rings ATCoat + rolling elements Si_3N_4

Design

BSD	standard design - 60° contact angle with circumferential lubrication groove
BSDF	flange type - 60° contact angle with 2x M6 connecting thread for lubrication
BSDFA	flange type - 60° contact angle with stepped outer ring flanged on both sides

Bore diameter

30 M	Bore 30 mm, standard series
30 MS	Bore 30 mm, heavy series

Outside diameter

Bearing outer diameter for BSD/BSDF
housing seat diameter for BSDFA
Details in mm

Seal

2RSZ	low-friction seal on both sides
2RZ	gap seal on both sides
2RS	contact seals on both sides

Lubrication

-	50% / GH62 (standard)
GN21G	30 – 35% / GN21

ATCoat coating

-	no coating
A11	inner and outer ring coated
A11L	outer and inner ring raceway coated
A11LF	inner and outer ring raceway coated and finished
A15	outer and inner ring coated rolling elements and cage corrosion resistant
A21	inner ring coated

Preload

BM	medium
BH	high

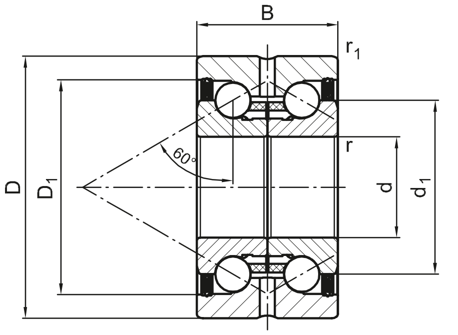
Angular rontact ball bearing set

-	single rolling bearing
D...-2	duplex set

Accuracy

P4
PW

4.2.2 BSD...BM and BSD...DBM-2 series



x53-008

Basic dimensions			Basic designation	Load ratings		Pre-load	Axial stiffness	Speed grease	Frictional torque	Tilting stiffness	Inertial torque	Precision locknut* inertia tightening torque		
				dyn.	stat.			2RSZ				Basic desig-nation	Nut	Locking device
d	D	B		C_a	C_{oa}	F_v	S_a	n_F	M_R	S_{AK}	M_J		M_D	M_A
mm				N			N/µm	rpm	Nm	Nm/mrad	kg • cm²		Nm	
Standard series														
8	32	20	BSD 08M32.2RSZ.BM	14,500	18,800	450	290	11,100	0.075	25	0.03	MMR 8	1.2	2
10	34	20	BSD 10M34.2RSZ.BM	14,500	18,800	450	290	11,100	0.075	25	0.03	MMR 10	1.2	2
12	42	25	BSD 12M42.2RSZ.BM	18,200	24,700	600	325	9,800	0.100	50	0.07	MMR 12	2.2	
15	45		BSD 15M45.2RSZ.BM	19,300	28,000	700	365	9,100	0.125	65	0.10	MMR 15	3.2	
17	47		BSD 17M47.2RSZ.BM	20,300	31,000	750	445	6,600	0.150	80	0.13	MMR 17	3.8	4
20	52	28	BSD 20M52.2RSZ.BM	28,000	47,000	1,650	600	6,500	0.190	140	0.27	MBA 20	10	2
25	57		BSD 25M57.2RSZ.BM	29,600	55,000	1,900	700	5,900	0.250	200	0.49	MBA 25	14	
30	62		BSD 30M62.2RSZ.BM	31,200	64,000	2,200	800	5,400	0.310	300	0.73	MBA 30	20	
35	72	34	BSD 35M72.2RSZ.BM	44,100	89,000	2,250	820	5,100	0.375	400	1.50	MBA 35	24	7
40	75		BSD 40M75.2RSZ.BM	46,300	101,000	2,600	930	5,000	0.440	550	2.25	MBA 40	31	
50	90		BSD 50M90.2RSZ.BM	50,000	126,000	3,100	1,130	4,500	0.560	1,000	5.25	MBA 50	46	
60	110	45	BSD 60M110.2RSZ.BM	90,300	214,000	4,700	1,300	3,600	1.250	1,650	13.70	MBA 60	73	9
Heavy series														
30	72	38	BSD 30MS72.2RSZ.BM	63,500	108,000	4,000	925	4,200	0.500	400	1.90	MBA 30	36	2
40	90	46	BSD 40MS90.2RSZ.BM	77,400	149,000	4,800	1,125	4,100	0.810	750	5.50	MBA 40	58	7
50	110	54	BSD 50MS110.2RSZ.BM	121,500	250,000	5,700	1,350	3,900	1.625	1,500	15.20	MBA 50	85	

See page 46 for pillow block unit housings with BSD bearings in the Ø range 10 to 15 mm

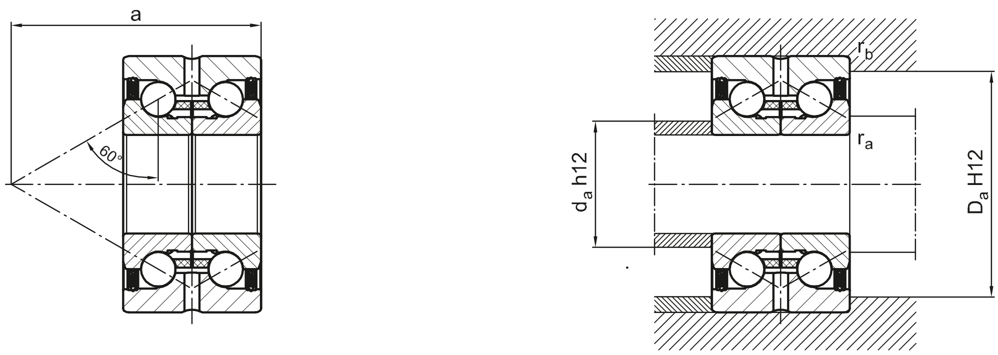
For precision locknuts see pages 78 ff.

** For constructions with precision 60° ball screw support bearings of the BS and BSD series (from Ø 20) in a separate housing and directly behind this sitting locknuts we recommend for reasons of access to the locking devices using the axial locknuts of the MBA and MBAS series. The MMRB precision locknut from page 78 can also be used for free radial accessibility*

With smaller diameters, the accessibility of the radial locking devices is provided via a clearing hole, a spacer at the housing or, even better, via a labyrinth seal of the S series, which the housing should be matched to. For information on this see section 7: IBC precision components, from page 73

The nuts of the same width of the MMRB series with radial locking can be used for the BSDF series with built-in fastening holes. More details on this are given in section 7: IBC precision components, from page 73

The frictional torques apply to rolling bearings with a low-contact seal (RSZ)
The values are 20% lower for the gap seal (RZ)
In the case of the contact seal (RS), double the values of RZ apply

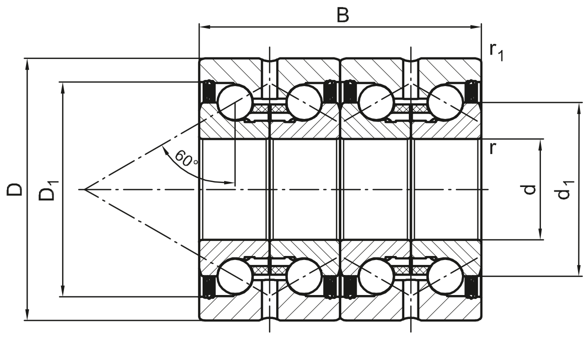


x53-015

Basic dimensions			Basic designation	Dimensions					Weight	Mounting dimensions			
d	D	B		a	d_1	D_1	r	r_1	m	d_{amin}	D_{amax}	r_{amax}	r_{bmax}
mm				mm					kg	mm			
Standard series													
8	32	20	BSD 08M32.2RSZ.BM	34	21	28	0.3	0.6	0.090	14	28	0.3	0.6
10	34	20	BSD 10M34.2RSZ.BM	34	21	28	0.3	0.6	0.100	14	28	0.3	0.6
12	42	25	BSD 12M42.2RSZ.BM	42	25	33			0.200	16	33		
15	45		BSD 15M45.2RSZ.BM	45	28	36			0.210	20	36		
17	47		BSD 17M47.2RSZ.BM	46.5	30	38			0.220	23	38		
20	52	28	BSD 20M52.2RSZ.BM	52.2	34.5	43			0.310	25	43		
25	57		BSD 25M57.2RSZ.BM	46.5	40.5	49			0.340	32	49		
30	62		BSD 30M62.2RSZ.BM	60.8	45.5	54			0.390	40	54		
35	72	34	BSD 35M72.2RSZ.BM	71.8	52	62			0.510	45	62		
40	75		BSD 40M75.2RSZ.BM	75.3	58	68			0.610	50	68		
50	90		BSD 50M90.2RSZ.BM	86.1	72	82	0.6		0.880	63	82	0.6	
60	110	45	BSD 60M110.2RSZ.BM	107.1	85	100			2.200	82	100		
Heavy series													
30	72	38	BSD 30MS72.2RSZ.BM	72.7	51	65	0.3	0.6	0.770	47	65	0.3	0.6
40	90	46	BSD 40MS90.2RSZ.BM	90.8	65	79			0.850	56	79		
50	110	54	BSD 50MS110.2RSZ.BM	110	80	98	0.6		2.500	63	98	0.6	

See page 46 for pillow block unit housings with BSD bearings in the Ø range 10 to 15 mm

BSD...DBM-2 series, paired



x53-007

Basic dimensions d	D	B	Basic designation	Load ratings dyn. C_a	stat. C_{oa}	Pre-load F_v	Axial stiffness S_a	Speed grease n_F	Frictional torque M_R	Tilting stiffness S_{AK}	Inertial torque M_J	Precision locknut* Basic designation	inertia tightening torque Nut M_D	Locking device M_A
mm				N			N/µm	rpm	Nm	Nm/mrad	kg • cm²		Nm	
Standard series														
8	32	40	BSD 08M32.RSZ.DBM-2	23,500	37,600	900	520	7,500	0.150	65	0.06	MMR 8	2.5	2
10	34	40	BSD 10M34.RSZ.DBM-2	23,500	37,600	900	520	7,500	0.150	65	0.06	MMR 10	2.5	2
12	42	50	BSD 12M42.RSZ.DBM-2	29,600	49,400	1,200	580	6,700	0.210	125	0.14	MMR 12	4.4	
15	45		BSD 15M45.RSZ.DBM-2	31,300	56,000	1,400	650	6,200	0.250	160	0.20	MMR 15	6.4	
17	47		BSD 17M47.RSZ.DBM-2	32,900	62,000	1,500	800	5,800	0.300	200	0.26	MMR 17	7.6	4
20	52	56	BSD 20M52.RSZ.DBM-2	45,500	94,000	3,300	1,080	4,400	0.375	320	0.54	MBA 20	20	2
25	57		BSD 25M57.RSZ.DBM-2	48,100	110,000	3,800	1,260	4,000	0.500	450	0.98	MBA 25	28	
30	62		BSD 30M62.RSZ.DBM-2	50,700	128,000	4,400	1,440	3,500	0.625	600	1.46	MBA 30	40	
35	72	68	BSD 35M72.RSZ.DBM-2	71,700	178,000	4,500	1,470	3,400	0.750	900	3.00	MBA 35	48	7
40	75		BSD 40M75.RSZ.DBM-2	75,100	202,000	5,200	1,670	3,300	0.875	1,200	4.50	MBA 40	62	
50	90		BSD 50M90.RSZ.DBM-2	81,300	252,000	6,200	2,030	3,000	1.125	2,200	10.50	MBA 50	92	
60	110	90	BSD 60M110.RSZ.DBM-2	146,700	428,000	9,400	2,340	2,900	2.500	3,600	27.40	MBA 60	144	9
Heavy series														
30	72	76	BSD 30MS72.RSZ.DBM-2	103,100	116,000	8,000	1,660	2,800	1.000	900	3.80	MBA 30	72	2
40	90	92	BSD 40MS90.RSZ.DBM-2	125,800	298,000	9,600	2,020	2,700	1.625	1,650	11.00	MBA 40	116	7
50	110	108	BSD 50MS110.RSZ.DBM-2	197,400	500,000	11,400	2,430	2,600	3.250	3,300	30.40	MBA 50	170	

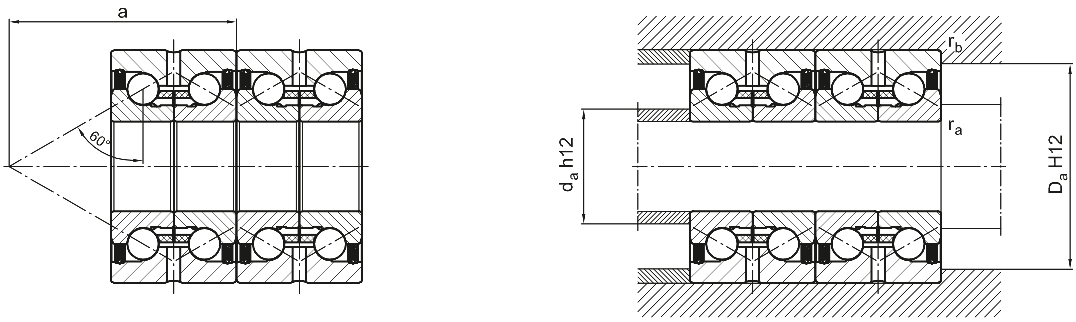
Precision locknuts see page 78 ff.

** For constructions with precision 60° ball screw support bearings of the BS and BSD series (from Ø 20) in a separate housing and directly behind this sitting locknuts we recommend for reasons of access to the locking devices using axial locking nuts of the MBA and MBAS series. The MMRB precision locknut from page 78 can also be used for free radial accessibility*

With smaller diameters, the accessibility of the radial locking devices is provided via a clearing hole, a spacer at the housing or, even better, via a labyrinth seal of the S series, which the housing should be matched to. For information on this see section 7: IBC precision components, from page 73

The nuts of the same width of the MMRB series with radial locking can be used for the BSDF series with built-in fastening holes. More details on this are given in section 7: IBC precision components, from page 73

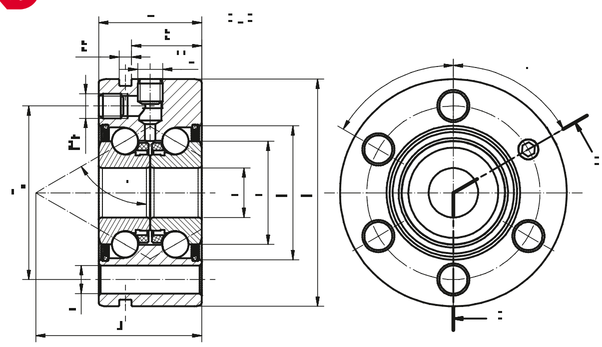
The frictional torques apply to rolling bearings with a low-contact seal (RSZ)
The values are 20% lower for the gap seal (RZ)
In the case of the contact seal (RS), double the values of RZ apply



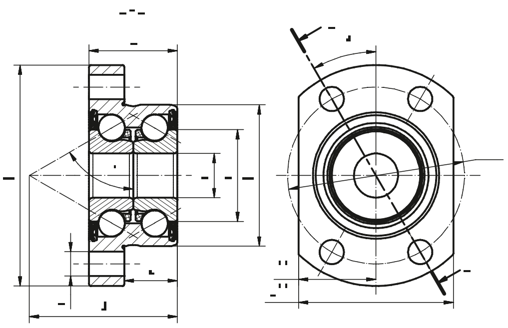
x53-006

Basic dimensions			Basic designation	Dimensions					Weight	Mounting dimensions			
d	D	B		a	d_1	D_1	r	r_1	m	d_{amin}	D_{amax}	r_{amax}	r_{bmax}
	mm					mm			kg		mm		
				Standard series									
8	32	20	BSD 08M32.RSZ.DBM-2	34	21	28	0.3	0.6	0.180	14	28	0.3	0.6
10	34	40	BSD 10M34.RSZ.DBM-2	34	21	28	0.3	0.6	0.200	14	28	0.3	0.6
12	42	50	BSD 12M42.RSZ.DBM-2	42	25	33			0.400	16	33		
15	45		BSD 15M45.RSZ.DBM-2	45	28	36			0.420	20	36		
17	47		BSD 17M47.RSZ.DBM-2	46.5	30	38			0.440	23	38		
20	52	56	BSD 20M52.RSZ.DBM-2	52.2	34.5	43			0.620	25	43		
25	57		BSD 25M57.RSZ.DBM-2	56.5	40.5	49			0.680	32	49		
30	62		BSD 30M62.RSZ.DBM-2	60.8	45.5	54			0.780	40	54		
35	72	68	BSD 35M72.RSZ.DBM-2	71.8	52	62			1.020	45	62		
40	75		BSD 40M75.RSZ.DBM-2	75.3	58	68			1.220	50	68		
50	90		BSD 50M90.RSZ.DBM-2	86.1	72	82	0.6		1.760	63	82	0.6	
60	110	90	BSD 60M110.RSZ.DBM-2	107	85	100			4.400	82	100		
				Heavy series									
30	72	38	BSD 30MS75.RSZ.DBM-2	72.7	51	65	0.3	0.6	1.440	47	65	0.3	0.6
40	90	46	BSD 40MS90.RSZ.DBM-2	90.8	65	79			1.900	56	79		
50	110	54	BSD 50MS110.RSZ.DBM-2	110	80	98	0.6		5.000	63	98	0.6	

4.2.3 BSDFA...BM, BSDF...BM and BSDF...DBM-2 series



BSDF



BSDFA

x53-022

Basic dimensions			Basic designation	Load ratings		Pre-load	Axial stiffness	Speed grease	Frictional torque	Tilting stiffness	Inertial torque	Precision locknut* inertia tightening torque		
				dyn.	stat.							Basic designation	Nut	Locking device
d	D	B		C_a	C_{oa}	F_v	S_a	n_F	M_R	S_{AK}	M_J		M_D	M_A
mm				N			N/µm	rpm	Nm	Nm/mrad	kg • cm²		Nm	
Standard series														
8	32	20	BSDFA 08M32.2RSZ.BM	14,500	18,800	450	290	11,100	0.075	25	0.03	MMR 8	1.2	2
10	32		BSDFA 10M32.2RSZ.BM	14,500	18,800	450	290	11,100	0.075	25	0.03	MMR 10	1.2	
12	55	25	BSDF 12M55.2RSZ.BM	18,200	24,700	600	325	9,800	0.100	50	0.07	MMR 12	2.2	
12	42		BSDFA 12M42.2RSZ.BM	18,200	24,700	600	325	9,800	0.100	50	0.07	MMR 12	2.2	
15	60		BSDF 15M60.2RSZ.BM	19,300	28,000	700	365	9,100	0.125	65	0.10	MMR 15	3.2	
15	42		BSDFA 15M42.2RSZ.BM	19,300	28,000	700	365	9,100	0.125	65	0.10	MMR 15	3.2	
17	62		BSDF 17M62.2RSZ.BM	20,300	31,000	750	445	8,500	0.150	80	0.13	MMR 17	3.8	
20	68	28	BSDF 20M68.2RSZ.BM	28,000	47,000	1,650	600	6,500	0.190	140	0.27	MBA 20	10	
25	75		BSDF 25M75.2RSZ.BM	29,600	55,000	1,900	700	5,900	0.250	200	0.49	MBA 25	14	
30	80		BSDF 30M80.2RSZ.BM	31,200	64,000	2,200	800	5,200	0.310	300	0.73	MBA 30	20	7
35	90	34	BSDF 35M90.2RSZ.BM	44,100	89,000	2,250	820	5,100	0.375	400	1.50	MBA 35	24	
40	100		BSDF 40M100.2RSZ.BM	46,300	101,000	2,600	930	5,000	0.440	550	2.25	MBA 40	31	
50	115		BSDF 50M115.2RSZ.BM	50,000	126,000	3,100	1,130	4,500	0.560	1,000	5.25	MBA 50	46	
60	145	45	BSDF 60M145.2RSZ.BM	90,300	214,000	4,700	1,300	3,600	1.250	1,650	13.70	MBA 60	73	9
Heavy series														
30	100	38	BSDF 30MS100.2RSZ.BM	63,500	108,000	4,000	925	4,200	0.500	400	1.90	MBA 30	36	2
40	115	46	BSDF 40MS115.2RSZ.BM	77,400	149,000	4,800	1,125	4,100	0.810	750	5.50	MBA 40	58	7
50	140	54	BSDF 50MS140.2RSZ.BM	121,500	250,000	5,700	1,350	3,900	1.625	1,500	15.00	MBA 50	85	

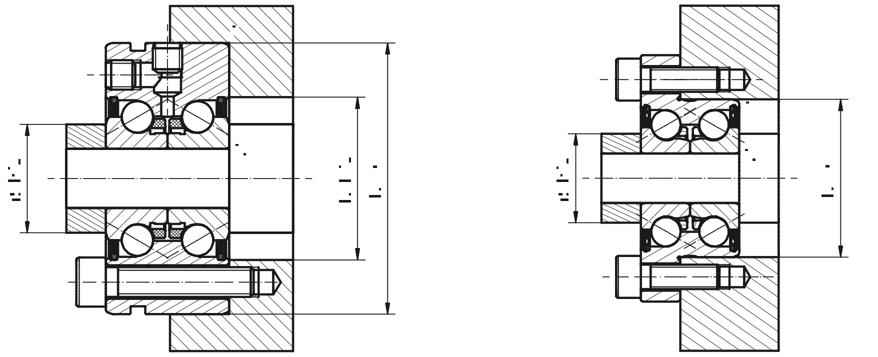
Precision locknuts see page 78 ff.

** For constructions with precision 60° ball screw support bearings of the BS and BSD series (from Ø 20) in a separate housing and directly behind this sitting locknuts we recommend for reasons of access to the locking devices using axial locking nuts of the MBA and MBAS series. The MMRB precision locknut from page 78 can also be used for free radial accessibility*

With smaller diameters, the accessibility of the radial locking devices is provided via a clearing hole, a spacer at the housing or, even better, via a labyrinth seal of the S series, which the housing should be matched to. For information on this see section 7: IBC precision components, from page 73

The nuts of the same width of the MMRB series with radial locking can be used for the BSDF series with built-in fastening holes. More details on this are given in section 7: IBC precision components, from page 73

The frictional torques apply to rolling bearings with a low-contact seal (RSZ)
The values are 20% lower for the gap seal (RZ)
In the case of the contact seal (RS), double the values of RZ apply



x53-023

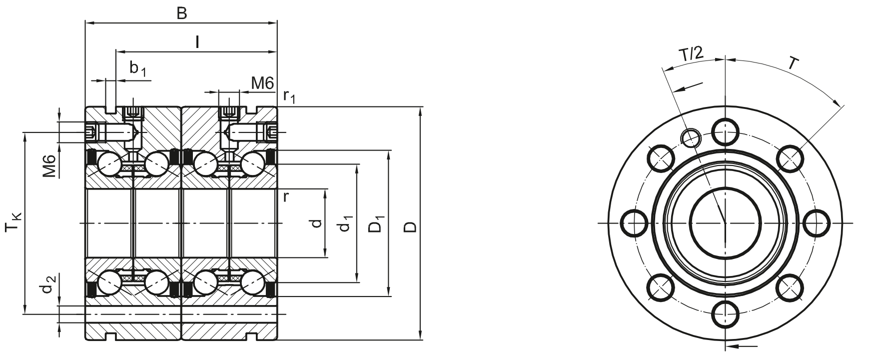
Basic dimensions			Basic designation	Fastening screws DIN 912-10.9			Dimensions												Weight	Mounting dimensions				
				Screw size	Number	Pitch n x T																		
d	D	B					a	d_1	D_1	D_3	r	r_1	T_K	d_2	b_1	b_2	L_1	M	m	d_{amin}	d_{amax}	D_{amax}	r_{amax}	r_{bmax}
mm							mm												kg	mm				
Standard series																								
8	32	20	BSDFA 08M32.2RSZ.BM	M5 x 25	4	2x2x30°	34	21	-	50	0.3	0.6	40	5.5	-	-	12	17.5	0.170	14	27	-	0.3	0.6
10	32		BSDFA 10M32.2RSZ.BM	M5 x 25	4	2x2x30°	34	21	-	50			40	5.5	-	-	12	17.5	0.180	14	27	-		
12	55	25	BSDF 12M55.2RSZ.BM	M6 x 40	5	6 x 60°	42	25	33	-			42	6.8	3	17	-	-	0.370	16	-	33		
12	42		BSDFA 12M42.2RSZ.BM	M6 x 30	4	2x2x30°	42	25	-	63			53	6.8	-	-	15	22.5	0.300	16	31	-		
15	60		BSDF 15M60.2RSZ.BM	M6 x 40	5	6 x 60°	45	28	36	-			46	6.8	3	17	-	-	0.430	20	-	36		
15	42		BSDFA 15M42.2RSZ.BM	M6 x 30	4	2x2x30°	45	28	-	63			53	6.8	-	-	15	22.5	0.310	20	34	-		
17	62		BSDF 17M62.2RSZ.BM	M6 x 40	5	6 x 60°	46.5	30	38	-			48	6.8	3	17	-	-	0.450	23	-	38		
20	68	28	BSDF 20M68.2RSZ.BM		7	8 x 45°	52.2	34.5	43	-			53			19	-	-	0.610	25	-	43		
25	75		BSDF 25M75.2RSZ.BM	M6 x 45			56.5	40.5	49	-			58				-	-	0.720	32	-	49		
30	80		BSDF 30M80.2RSZ.BM		11	12 x 30°	60.8	45.5	54	-			63				-	-	0.780	40	-	54		
35	90	34	BSDF 35M90.2RSZ.BM	M8 x 50	7	8 x 45°	71.8	52	62	-			75	8.8		25	-	-	1.130	45	-	62		
40	100		BSDF 40M100.2RSZ.BM				75.3	58	68	-			80				-	-	1.460	50	-	68		
50	115		BSDF 50M115.2RSZ.BM		11	12 x 30°	86.1	72	82	-			94				-	-	1.860	63	-	82		
60	145	45	BSDF 60M145.2RSZ.BM	M8 x 60	8	8 x 45°	107	85	100	-	0,6		120			35	-	-	4.300	82	-	100	0.6	
Heavy series																								
30	100	38	BSDF 30MS100.2RSZ.BM	M8 x 55	8	8 x 45°	72.7	51	65	-	0.3	0.6	80	8.8	3	30	-	-	1.630	47	-	65	0.3	0.6
40	115	46	BSDF 40MS115.2RSZ.BM	M8 x 65	12	12 x 30°	90.8	65	79	-			94			36	-	-	2.200	56	-	79		
50	140	54	BSDF 50MS140.2RSZ.BM	M10 x 70			110	80	98	-	0.6		113	11		45	-	-	4.700	63	-	98	0.6	

Double-row 60° ball screw support bearings of the BSDFA series offer an even more compact mounting option with their stepped flange. The centre height M is additionally reduced by milled cutouts on both sides. Simple mounting with four screws permits flat and compact wall mounting.

The basic constructions and the associated technical data correspond to the double-row 60° ball screw support bearings of the BSD and BSDF series with the same hole.

The bearing units are sealed on both sides, lubricated for life, and have an integrated lubrication groove.

BSDF...DBM-2 series, paired, flanged



x53-009

Basic dimensions d	D	B	Basic designation	Load ratings dyn. C_a	stat. C_{oa}	Pre-load F_v	Axial stiffness S_a	Speed grease n_F	Frictional torque M_R	Tilting stiffness S_{AK}	Inertial torque moment M_J	Precision locknut* Basic designation	inertia tightening torque Nut M_D	Locking device M_A
mm				N			N/µm	rpm	Nm	Nm/mrad	kg • cm²		Nm	
Standard series														
12	55	50	BSDF 12M55.RSZ.DBM-2	29,600	49,400	1,200	580	6,700	0.200	125	0.14	MMR 12	5	2
15	60		BSDF 15M60.RSZ.DBM-2	31,300	56,000	1,400	650	6,200	0.250	160	0.20	MMR 15	7	
17	62		BSDF 17M62.RSZ.DBM-2	32,900	62,000	1,500	800	5,800	0.300	200	0.26	MMR 17	8	4
20	68	56	BSDF 20M68.RSZ.DBM-2	45,500	94,000	3,300	1,080	4,400	0.375	320	0.54	MBA 20	20	2
25	75		BSDF 25M75.RSZ.DBM-2	48,100	110,000	3,800	1,260	4,000	0.500	450	0.98	MBA 25	28	
30	80		BSDF 30M80.RSZ.DBM-2	50,700	128,000	4,400	1,440	3,500	0.625	600	1.46	MBA 30	40	7
35	90	68	BSDF 35M90.RSZ.DBM-2	71,700	178,000	4,500	1,470	3,400	0.750	900	3.00	MBA 35	48	
40	100		BSDF 40M100.RSZ.DBM-2	75,100	202,000	5,200	1,670	3,300	0.875	1,200	4.50	MBA 40	62	
50	115		BSDF 50M115.RSZ.DBM-2	81,300	252,000	6,200	2,030	3,000	1.125	2,200	10.50	MBA 50	92	
60	145	90	BSDF 60M145.RSZ.DBM-2	146,700	428,000	9,400	2,340	2,900	2.500	3,600	27.40	MBA 60	144	9
Heavy series														
30	100	76	BSDF 30MS100.RSZ.DBM-2	103,100	215,000	8,000	1,660	2,800	1.000	900	3.80	MBA 30	72	2
40	115	92	BSDF 40MS115.RSZ.DBM-2	125,800	298,000	9,600	2,020	2,700	1.625	1,650	11.00	MBA 40	116	7
50	140	108	BSDF 50MS140.RSZ.DBM-2	197,400	500,000	11,400	2,430	2,600	3.250	3,300	30.00	MBA 50	170	

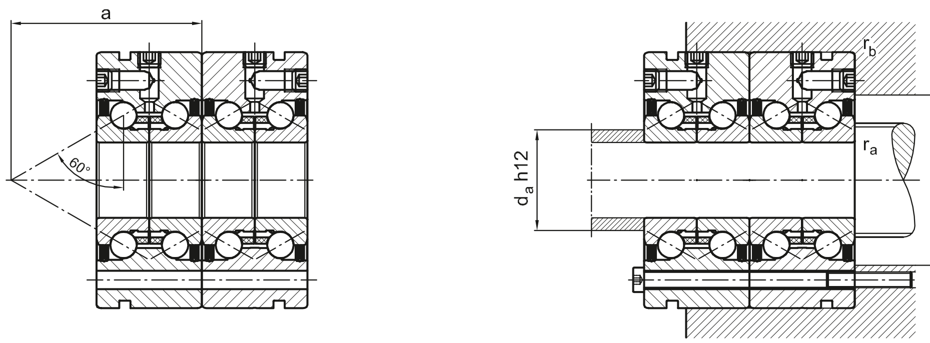
Precision locknuts see page 78 ff.

** For constructions with precision 60° ball screw support bearings of the BS and BSD series (from Ø 20) in a separate housing and directly behind this sitting locknuts we recommend for reasons of access to the locking devices using axial locking nuts of the MBA and MBAS series. The MMRB precision locknut from page 78 can also be used for free radial accessibility*

With smaller diameters, the accessibility of the radial locking devices is provided via a clearing hole, a spacer at the housing or, even better, via a labyrinth seal of the S series, which the housing should be matched to. For information on this see section 7: IBC precision components, from page 73

The nuts of the same width of the MMRB series with radial locking can be used for the BSDF series with built-in fastening holes. More details on this are given in section 7: IBC precision components, from page 73

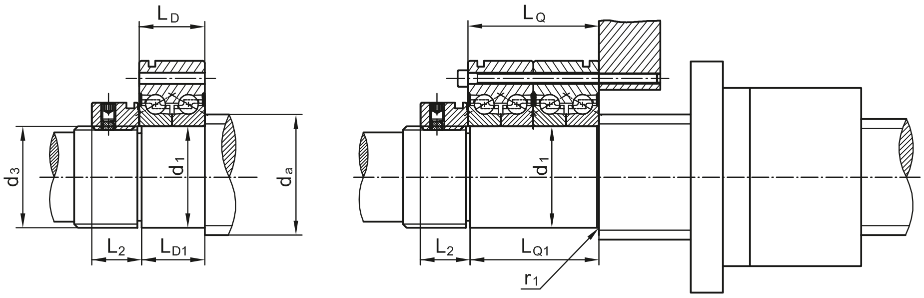
The frictional torques apply to rolling bearings with a low-contact seal (RSZ)
The values are 20% lower for the gap seal (RZ)
In the case of the contact seal (RS), double the values of RZ apply



x53-010

Basic dimensions			Basic designation	Fastening screws DIN 912-10.9			Dimensions									Weight	Mounting dimensions			
				Screw-size	Number	Pitch														
d	D	B				n x T	a	d_1	D_1	r	r_1	T_K	d_2	b_1	l	m	d_{amin}	D_{amax}	r_{amax}	r_{bmax}
mm							mm									kg	mm			
Standard series																				
12	55	50	BSDF 12M55.RSZ.DBM-2	M6 x 65	5	6 x 60°	42	25	33	0.3	0.6	42	6.8	3	42	0.740	16	33	0.3	0.6
15	60		BSDF 15M60.RSZ.DBM-2				44.7	28	36			46				0.860	20	36		
17	62		BSDF 17M62.RSZ.DBM-2				46.5	30	38			48				0.900	23	38		
20	68	56	BSDF 20M68.RSZ.DBM-2	M6 x 70	7	8 x 45°	52.2	34.5	43			53			47	1.220	25	43		
25	75		BSDF 25M75.RSZ.DBM-2				56.5	40.5	49			58				1.440	32	49		
30	80		BSDF 30M80.RSZ.DBM-2		11	12 x 30°	60.8	45.5	54			63				1.560	40	54		
35	90	68	BSDF 35M90.RSZ.DBM-2	M8 x 80	7	8 x 45°	71.8	52	62			75	8.8		59	2.260	45	62		
40	100		BSDF 40M100.RSZ.DBM-2				75.3	58	68			80				2.920	50	68		
50	115		BSDF 50M115.RSZ.DBM-2		11	12 x 30°	86.1	72	82			94				3.720	63	82		
60	145	90	BSDF 60M145.RSZ.DBM-2	M8 x 110	8	8 x 45°	107	85	100	0.6		120			80	8.600	82	100	0.6	
Heavy series																				
30	100	76	BSDF 30MS100.RSZ.DBM-2	M8 x 90	8	8 x 45°	72.7	51	65	0.3	0.6	80	8.8	3	68	3.260	47	65	0.3	0.6
40	115	92	BSDF 40MS115.RSZ.DBM-2	M8 x 110	12	12 x 30°	90.8	65	79			94			82	4.400	56	79		
50	140	108	BSDF 50MS140.RSZ.DBM-2	M10 x 125			110	80	98	0.6		113	11		99	9.400	63	98	0.6	

4.2.4 Mounting dimensions of ball screw spindles for precision locating bearings



x53-610

Basic designation		d_1	d_{amin}	d_3	L_D	L_{D1}	L_Q	L_{Q1}	r_{1max}	L_{2min}	Tolerance of the shaft d_1
		mm									µm
Standard series											
BSD 10M34	-	10	14	10 x 0.75	20	18	40	38	0.3	10	-2 / -6
BSD 12M42	BSDF 12M55	12	16	12 x 1	25	23	50	48			
BSD 15M45	BSDF 15M60	15	20	15 x 1							
BSD 17M47	BSDF 17M62	17	23	17 x 1	28	26	56	54		12	-3 / -7
BSD 20M52	BSDF 20M68	20	25	20 x 1						16	
BSD 25M57	BSDF 25M75	25	32	25 x 1.5						20	
BSD 30M62	BSDF 30M80	30	40	30 x 1.5							
BSD 35M72	BSDF 35M90	35	45	35 x 1.5	34	32	68	66			-4 / -8
BSD 40M75	BSDF 40M100	40	50	40 x 1.5						22	
BSD 50M90	BSDF 50M115	50	63	50 x 1.5							
BSD 60M110	BSDF 60M145	60	82	60 x 2	45	43	90	88	0.6	24	-4 / -9
Heavy series											
BSD 30M72	BSDF 30M100	30	47	30 x 1.5	38	36	72	70	0.3	20	-4 / -8
BSD 40M90	BSDF 40M115	40	56	40 x 1.5	46	44	92	90		22	
BSD 50M110	BSDF 50M140	50	63	50 x 1.5	54	52	108	106	0.6		

The mounting dimensions apply for the BSD…BM, BSD…DBM-2 and BSDF…BM, BSDF…DBM-2 series

Matching precision locknuts for rolling bearings Ø 10 to 17 mm: MMR series see page 78
Matching precision locknuts for rolling bearings Ø above 20 mm: See page 78 for the MMRB series and page 78 for the MBA series

See page 52 of this publication for floating bearing connection

4.3 Tolerances and fits for IBC precision 60° ball screw support bearings and adjacent parts

IBC precision 60° ball screw support bearing, single-row, of the BS series

Inner ring [mm] Characteristics	Dimensional and running tolerances Tolerance class	Ø 10 to 18	18 30	30 50	50 80	80 120	120 180
Maximum deviation of the mean bore diameter from the nominal (Δ_{dmp})	P4	-4	-5	-6	-7	-8	-10
	P4A, P2H	-4	-4	-5	-6	-6	-7.5
Runout of the front side related to the raceway of the inner ring of the assembled rolling bearing	P4	3	4	4	5	5	7
	P4A, P2H	2.5	2.5	2.5	2.5	2.5	2.5
Deviation of a single inner ring width (Δ_{Bs})	P4,	-250	-250	-250	-300	-350	-400
	P4A, P2H	-200	-200	-200	-250	-300	-350
Outer ring [mm] Characteristics	**Tolerance class**	**Ø 30 to 50**	**50 80**	**80 120**	**120 150**	**150 180**	**180 250**
Maximum deviation of the mean outer diameter from the nominal (Δ_{Dmp})	P4, P4A, P2H	-6	-7	-8	-9	-10	-11

Table 4.1: Dimensional and running tolerances of IBC 60° ball screw support bearings, specifications in µm

The actual value bore codes for Δ_{dmp} and Δ_{Dmp} are marked on the inner and outer rings respectively.

Double-row IBC precision 60° ball screw support bearings as individual bearings or duplex sets of the BSD, BSDFA and BSDF series

Inner ring [mm] Characteristics	Dimentional and running tolerances Tolerance class	Ø 10 to 25	25 50	> 50
Maximum deviation of the mean bore diameter from the nominal (Δ_{dmp})	PW	-10	-10	-15
	P4	-5	-5	-8
Runout of the front side related to the bore (S_d)	PW	5	6	7
	P4	2	2.5	3
Deviation of a single inner ring width (Δ_{Bs})	PW	-250	-250	-250
	P4	-250	-250	-250

Outer ring [mm] Characteristics	Tolerance class	Ø 34 to 47	50 72	72 110	> 110
Maximum deviation of the mean outer diameter from the nominal (Δ_{Dmp}), related to the outer diameter of the BSD series	PW	-12	-13	-15	-18
	P4	-10	-10	-10	-15

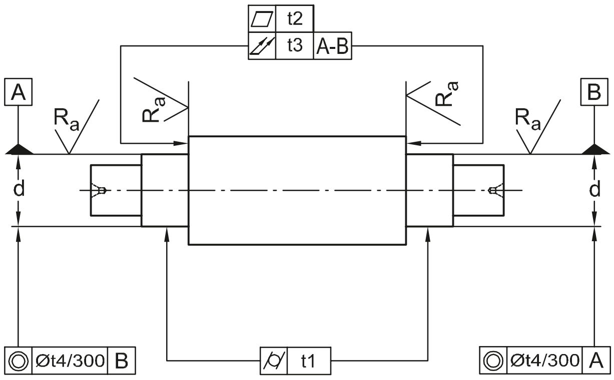
Table 4.2: Dimensional and running tolerances of double-row IBC 60° ball screw support bearings, specifications in µm

Recommended fits for adjacent parts								
d	**Nominal diameter shaft [mm]**	**Tolerance class**	**Ø 10 to 18**	**18 30**	**30 50**	**50 80**	**80 120**	**120 150**
Δd	**Shaft tolerance locating bearing**	P4A, P2H	-1 -6	-2 -6	-4 -8	-4 -9	-5 -10	-6 -12
D	**Nominal diameter housing [mm]**	**Tolerance class**	**Ø 30 to 50**	**50 80**	**80 120**	**120 150**	**150 180**	**180 250**
ΔD	**Housing tolerance locating bearing**	P4A, P2H	+5 0	+5 0	+5 -1	+7 -1	+7 -2	+7 -2

Table 4.3: Summary of tolerances for adjacent parts for IBC precision 60° ball screw support bearings, specifications in µm

For applications using floating bearings (from page 52) we recommend fits on the shaft in accordance with g4 or g5.

Form accuracy for shafts



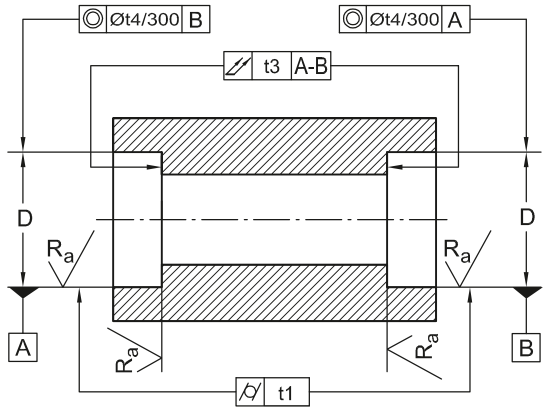
Characteristics	Tolerance symbol	Tolerance value	Permissible form and position deviations according to tolerance and roughness classes	
			PW	P4, P4A
Cylindricity	⌭	t1	IT5	IT2
Planarity	▱	t2	IT5	IT2
Total runout	⌰	t3	IT4	IT3
Concentricity	◎	t4	IT5	IT4
Roughness R_a d ≤ 80 mm		-	N6	N4
Roughness R_a d > 80 mm		-	N7	N5

Table 4.4: Form accuracy for shafts

ISO standard tolerances in accordance with DIN ISO 286 T1									
Diameter Nominal dimension		Tolerance grade							
over	up to	IT0	IT1	IT2	IT3	IT4	IT5	IT6	IT7
mm		µm							
6	10	0.6	1	1.5	2.5	4	6	9	15
10	18	0.8	1.2	2	3	5	8	11	18
18	30	1	1.5	2.5	4	6	9	13	21
30	50	1	1.5	2.5	4	7	11	16	25
50	80	1.2	2	3	5	8	13	19	30
80	120	1.5	2.5	4	6	10	15	22	35
120	180	2	3.5	5	8	12	18	25	40
180	250	3	4.5	7	10	14	20	29	46
250	315	4	6	8	12	16	23	32	52
315	400	5	7	9	13	18	25	36	57
400	500	6	8	10	15	20	27	40	63

Table 4.5: ISO standard tolerances in accordance with DIN ISO 286 T1

Form accuracy for housings



x45-603

Characteristics	Tolerance symbol	Tolerance value	Permissible form and position deviations according to tolerance and roughness classes	
			PW	P4, P4A
Cylindricity	⌭	t1	IT5	IT2
Planarity	▱	t2	IT5	IT2
Total runout	⌰	t3	IT5	IT3
Concentricity	◎	t4	IT6	IT4
Roughness R_a d ≤ 80 mm		-	N7	N6
80 mm < D ≤ 250 mm		-	N7	N6
D < 250 mm		-	N7	N7

Table 4.6: Form accuracy for housings

The roughness R_a of the axial contact surface of the spindle, in the housing and of spacer rings must be produced as follows:
For precision class PW: N7 = 1.6 µm
For precision class P4, P4A: N6 = 0.8 µm

Roughness class	Roughness value R_a
	µm
N3	0.1
N4	0.2
N5	0.4
N6	0.8
N7	1.6

Table 4.7: Roughness classes for bearing sets at shafts and housings

5. IBC precision bearing units for ball screws

IBC precision bearing units with labyrinth seals and lifetime lubrication are primarily used in the following applications:

- Cylindrical screw devices
- Ball screws (BS)
- Satellite screw drives
- Index tables
- Worm gears
- Special applications

Ball screws are mainly used in machine tools (millers, lathes, drills, eroding and grinding machines as well as machining centres). Further application areas are measuring machines and sheet metal processing machines (presses, straightening machines, bending machines, punches, laser cutting machines, laser marking machines and profiling machines) together with wood-working machines and special machinery. Ball screws are also used in control systems and robots.

There are extremely varied criteria for the bearings due to the large number of applications. In detail, precision bearing units must meet the following requirements:

- high axial stiffness and load ratings
- low friction and hence low heat generation
- suitability for high rotating speeds
- high running precision
- variable design (flange or pillow block construction)
- flexible arrangement
- high resistance to corrosion

IBC has developed a variable module system of a wide variety of precision bearing units to meet all kinds of requirements.

High degree of flexibility in designing variations

A number of precision bearing housings can be supplied with precision 60° ball screw support bearings of various bore sizes for the same outer dimensions. This has proven to be advantageous in machines with various stroke lengths, since ball screws of a greater diameter can be selected if the spindle limiting speed of rotation that is critical for bending is exceeded. This also allows the user to standardize the connecting components, since the outer dimensions are the same.

Simple and cost-effective mounting

Originally precision 60° ball screw support bearings were installed separately with other machine elements (Fig. 5.1 a).

Nowadays there is an increasing preference for units that are ready to install, since construction is made easier and quicker by installing associated assemblies. The manufacture of connecting components is made simpler by removing the axial contact surfaces in the locating bores. A contact surface that has been machined at right angles to the axis of the housing is sufficient for flange units. The bearing units can be preassembled and subsequently aligned radially in the final assembly (Fig. 5.1b).

There is also the option to produce exact location, by machining, the flange units on CNC machines with of the corresponding accuracy (Fig. 5.1 c).

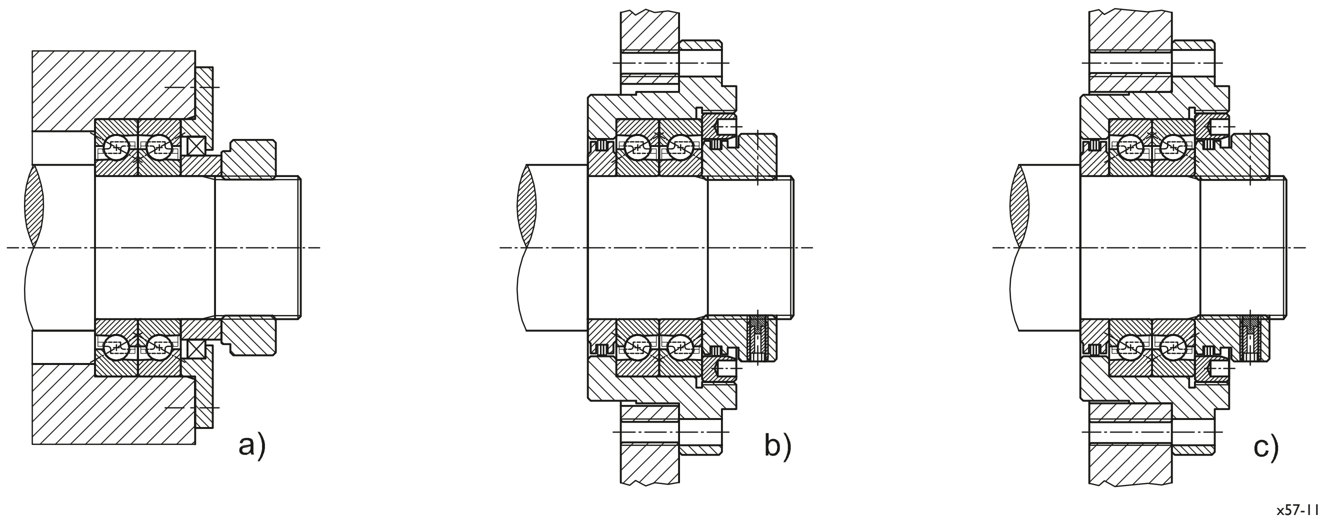


Fig. 5.1: Mounting examples for precision bearings for ball and roller screw drives

Advantages of precision flange units

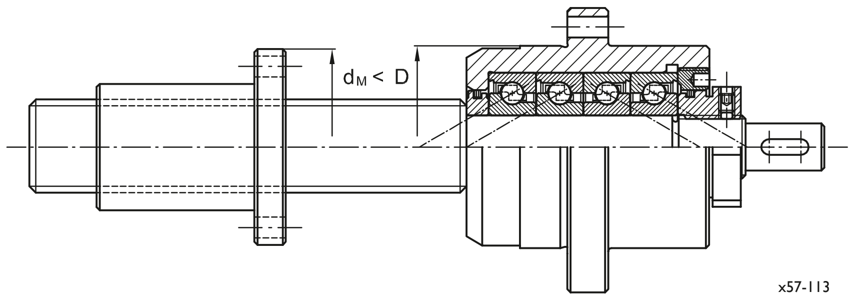
IBC BSBU and BSBU-M precision flange units with flattening on both sides can easily be incorporated into the design planning and are characterized by easier handling during mounting.

They have a low height due to the flats on both sides of the bearing units. This height (= 2 · centre height M_F) corresponds to the flange diameter D and was selected such that with the standardized sizes of ball screw spindles the flange outer diameter of the ball screw nut is somewhat smaller than the locating diameter of the precision bearing unit.

Technicians also greatly appreciate the simple replacement of the ball screw assembly with built-in bearings in servicing work as well. It is possible to easily pull out the entire assembly due to the optimally selected diameter (d_M < D, see Fig. 5.2) In the same way, a preassembled module can be installed again quickly, which reduces both maintenance times and downtime.

The precision locknuts with matched labyrinth seal integrated into the BSBU-M series ensure easy and guaranteed preloading of IBC precision flange units.

If the flange housing is installed from inside against a contact surface, the MMRS locknut and the seal S can also be replaced retrospectively against one another. This version can also be ordered from the factory with the addition, "I" for inverted type. Please note also the mounting information on page 90.



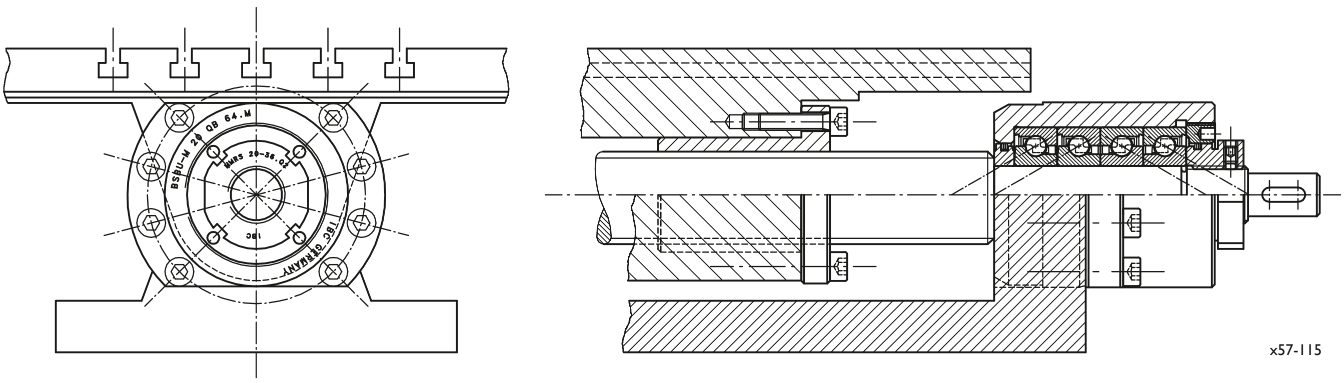


Fig. 5.2: Preassembled module with ball screw and precision flange unit of the BSBU-M series

Advantages of precision pillow block units

While earlier flange bearings had to be held with spigots, the use of IBC precision pillow block units means savings in the space required and shorter mounting times.

The reference dimensions that are held to close tolerances at the base of locating and floating bearing units of the series BSPB, BSPB-M and BLPB has proved to be especially advantageous (see pages 36 and 54 - Mounting dimensions). The IBC precision pillow block combination, consisting of a locating bearing of the BSPB-M series and a spring-preloaded floating bearing of the BSPB..D..DT series, is based on the same mounting dimensions. The locating surface for the units can thus be machined with that of the guides in one clamping operation. Predrilled pinholes allow precise fixing.

Applications of mounting with an axial load that is preliminary one-sided

In the case of bearings for spindles that are arranged vertically or diagonally, and which to some extent have to take up the not inconsiderable table weight, one load direction dominates for all load cycles as a result of gravity. In this case a unit with bearing arrangement 3:1 (with the suffix QBT) can be selected (see figures 5.3 and 5.4). The selection and design of the individual bearings and the stiffness and unloading factors can be calculated on the basis of the tables in sections 3.1 and 3.2 on pages 8 and 14. Information of further asymmetrical bearing arrangements can be found on page 90.

Bearings for driven ball screws

BNBU, BNBUS and BNPB precision bearing units with an adapter sleeve are offered for the bearings for driven ball screw nuts (in accordance with DIN 69051). Driven ball screws are used in particular in long ball screws. The low mass of the driven ball screw nut (see page 55 ff) with respect to the mass of the spindle is advantageous here.

A further advantage lies in the fact that the driven nut of the ball screw does not have to take up any pretension forces of the rolling bearings. The pretensioning of the spindle to preempt the thermal expansion in operation can be realized in an easy way during mounting and clamping.

Depending on the requirement for stiffness, limiting speed or frictional torque, it is possible to select between precision bearing units with light (L), medium (M) or high (H) preloading. The ordering designation is derived from the basic type and a suffix for the preloading. In the case of precision adapter units the thread hole pattern as well as the flange type can be selected with flange units.

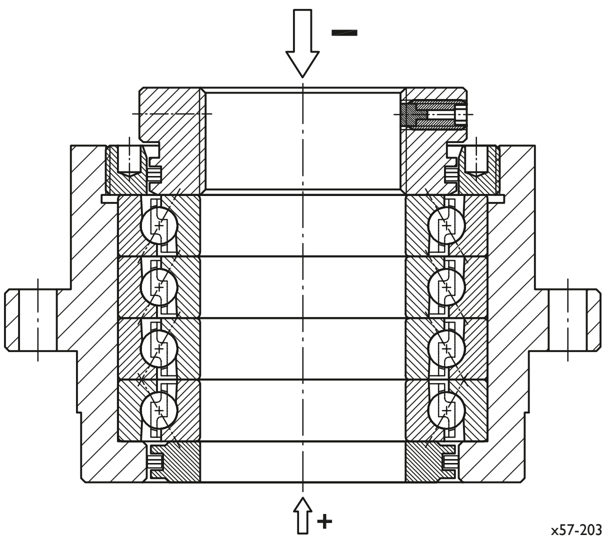


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Fig. 5.3: IBC precision bearing unit BSBU-M 40 Q 128.QBTM with arrangement < < < >

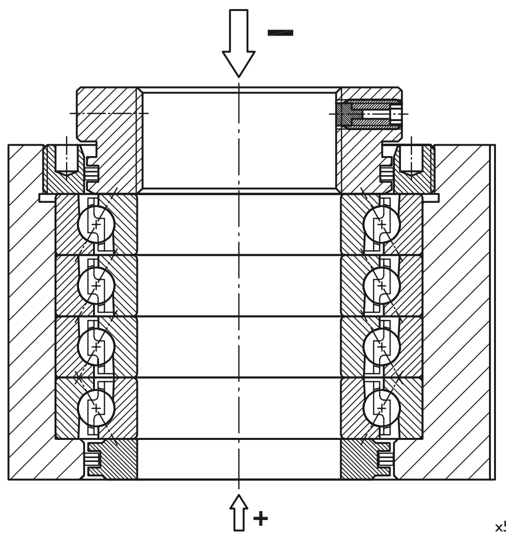

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Fig. 5.4: IBC precision bearing unit BSPB-M 40 Q 128.QBTM with arrangement < < < >

5.1 Designation system

Examples:

	BSBU	-MI	25	D	B	88			.QBT	M		
AC-	BSBU	-M	40	Q	B	128			.QBT	M		.A11L
	BNBUS		75	Q	B	178		2	.DB	L	-M2	
	BLPB		20	N		32	.2RS					

Material*

-	rolling elements and rings 100Cr6
CB	rolling elements Si_3N_4
AC-	rings ATCoat
ACC-	rings ATCoat + rolling elements Si_3N_4

Design

BS	locating bearing unit for ball screw spindles
BN	locating bearing unit for ball screw nuts
BL	floating bearing unit for spindle ends

Configuration

BU	flange unit
PB	pillow block unit

Integrated lubrication

-	none
S	integrated into the bearing unit

Locknut

-	order separately (MMRB)
-M	integrated
-MI	integrated nut - inverted mounting

Bore diameter

25	specifications in mm

Number and type of rolling bearings

D	duplex set
Q	quadruplex set
P	pentaplex set
N	needle roller bearings in floating bearing units

Flange form

-	round (standard for design BL) flat on one side for old design BSBU
B	flattened on both sides

Reference dimension

128	flange seat diameter in mm
32	centre height in mm for pillow block units

Lubrication

-	50% / GH62 (standard)
GN21G	30 – 35% / GN21

ATCoat coating*

-	no coating
A11	inner and outer ring coated
A11L	inner and outer ring raceway coated
A11LF	inner and outer ring raceway coated and finished
A15	inner and outer ring coated rolling elements and cage corrosion resistant steel
A21	inner ring coated
A31	outer ring coated
A31M	outer ring outer diameter coated

Mounting information adapter (BN-units)

-M1	locknut on housing nut side
-M2	locknut opposite housing nut

Preload

L	light
M	medium
H	high
U	preload in daN per bearing

Bearing arrangement

DB	arrangement <> not marked
QBC	arrangement <<>> not marked
QBT	arrangement <<<>
DT	arrangement << rolling bearings in tandem for spring-preloaded units
PBC	arrangement <<<>>
PBT	arrangement <<<<>

Hole pattern adapter

1	hole pattern 1 with 6 holes
2	hole pattern 2 with 8 holes

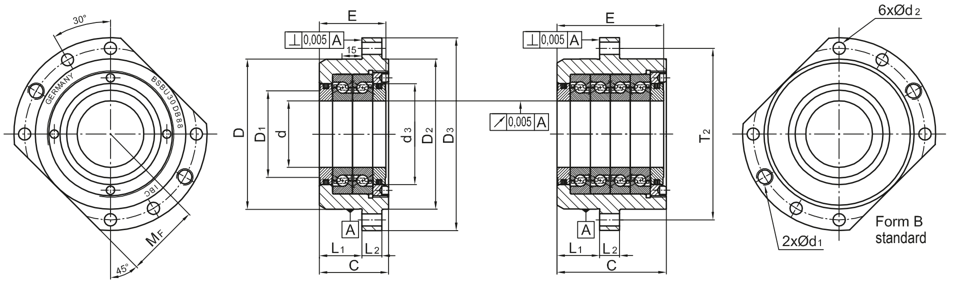
Seal

-	labyrinth-seal
2RS	seal for floating bearing units

** The details only relate to the installed rolling bearing components*

5.2 IBC precision flange locating bearing units

5.2.1 IBC precision flange locating units BSBU and BSBU-M series



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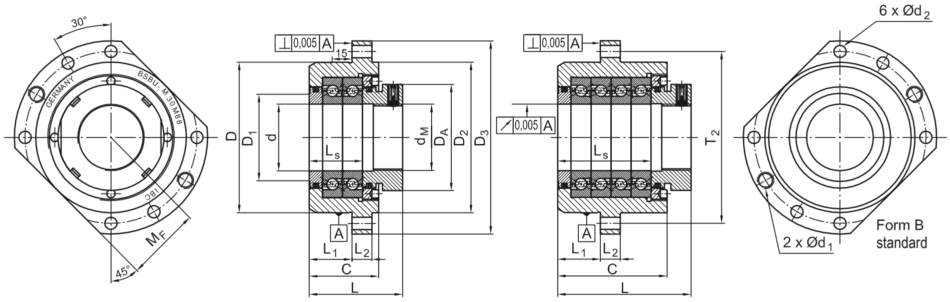
BSBU..DB.. BSBU..QB..

Shaft mm	Basic designation	d	D	M_F	C	E	d_1	d_2	d_3	D_1	D_2	D_3	Weight kg
		mm											
					Medium series								
17	BSBU 17 DB 64	17	64	32	47	44	M8	6,6	36	26	64	90	1.1
	BSBU 17 QB 64				77	74							1.7
20	BSBU 20 DB 64	20			47	44							1.1
	BSBU 20 QB 64				77	74							1.7
25	BSBU 25 DB 88	25	88	44	52	50	M12	9,2	50	40	88	120	2.3
	BSBU 25 QB 88				82	80							3.5
30	BSBU 30 DB 88	30			52	50							2.2
	BSBU 30 QB 88				82	80							3.4
	BSBU 30 DB 98		98	49	52	50			60	46	98	130	3.3
	BSBU 30 QB 98				82	80							4.7
35	BSBU 35 DB 98	35			52	50							3.2
	BSBU 35 QB 98				82	80							4.6
40	BSBU 40 DB 98	40			52	50				50			3.1
	BSBU 40 QB 98				82	80							4.5
45	BSBU 45 DB 98	45			52	50				55			3.8
	BSBU 45 QB 98				82	80							4.6
55	BSBU 55 DB 113	55	113	56,5	52	50			76	68	113	145	3.4
	BSBU 55 QB 113				82	80							5.1
75	BSBU 75 DB 138	75	138	69	54	50			99	86	138	170	4.1
	BSBU 75 QB 138				84	80							6.3
					Heavy series								
35	BSBU 35 DB 128	35	128	64	66	64	M14	11.4	76	66	128	165	6.3
	BSBU 35 QB 128				106	104							10.1
40	BSBU 40 DB 128	40			66	64							6.1
	BSBU 40 QB 128				106	104							9.7
45	BSBU 45 DB 128	45			66	64							6
	BSBU 45 QB 128				106	104							9.5
50	BSBU 50 DB 128	50			66	64				68			5.9
	BSBU 50 QB 128				106	104							9.3
55	BSBU 55 DB 148	55	148	74	66	64			99	86	148	185	8.2
	BSBU 55 QB 148				106	104							12.9
60	BSBU 60 DB 148	60			66	64							7.9
	BSBU 60 QB 148				106	104							12.5
80	BSBU 80 DB 210	80	210	105	126	126	M20	17.5	132	120	210	270	30.5
	BSBU 80 QB 210				204	204							45.9
	BSBU 80 PB 210				243	243							53.6
100	BSBU 100 DB 256	100	256	128	142	142	M24	22	162	142	256	322	50.1
	BSBU 100 QB 256				236	236							77.6

Tolerances	d	D	E (Duplex)	E (Quad)
		mm		
BSBU 17 DB/QB 64 – BSBU 30 DB/QB 88	0 / -0.005	0 / -0.013	0 / -1.02	0 / -1.52
BSBU 30 DB/QB 98 – BSBU 45 DB/QB 98		0 / -0.015		
BSBU 55 DB/QB 113 – BSBU 60 DB/QB 148		0 / -0.018		
BSBU 80 DB/QB/PB 210		0 / -0.020		
BSBU 100 DB/QB 256	0 / -0.006	0 / -0.023		

Technical data see page 50

Recommended locknut MMRB-… from page 78



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BSBU-M..DB..

BSBU-M..QB..

T_2	L_1	L_2 (mm)	D_A	L_S	L	Integrated locknut (see page 84)	Basic designation	Shaft (mm)
Medium series								
76	32	13	38	37	57	MMRS 17-36	BSBU-M 17 DB 64	17
				64	87		BSBU-M 17 QB 64	
				37	57	MMRS 20-36	BSBU-M 20 DB 64	20
				67	87		BSBU-M 20 QB 64	
102		15	58	40	65	MMRS 25-50	BSBU-M 25 DB 88	25
				70	95		BSBU-M 25 QB 88	
				40	65	MMRS 30-50	BSBU-M 30 DB 88	30
				70	95		BSBU-M 30 QB 88	
113			70	40	68	MMRS 30-60	BSBU-M 30 DB 98	
				70	98		BSBU-M 30 QB 98	
				40	68	MMRS 35-60	BSBU-M 35 DB 98	35
				70	98		BSBU-M 35 QB 98	
				40	68	MMRS 40-60	BSBU-M 40 DB 98	40
				70	98		BSBU-M 40 QB 98	
				40	68	MMRS 45-60	BSBU-M 45 DB 98	45
				70	98		BSBU-M 45 QB 98	
129			80	40	70	MMRS 55-76	BSBU-M 55 DB 113	55
				70	100		BSBU-M 55 QB 113	
154			105	40	70	MMRS 75-99	BSBU-M 75 DB 138	75
				70	100		BSBU-M 75 QB 138	
Heavy series								
146	43,5	17	80	52	82	MMRS 35-76	BSBU-M 35 DB 128	35
				92	122		BSBU-M 35 QB 128	
				52	82	MMRS 40-76	BSBU-M 40 DB 128	40
				92	122		BSBU-M 40 QB 128	
				52	82	MMRS 45-76	BSBU-M 45 DB 128	45
				92	122		BSBU-M 45 QB 128	
				52	82	MMRS 50-76	BSBU-M 50 DB 128	50
				92	122		BSBU-M 50 QB 128	
166				52	82	MMRS 55-99	BSBU-M 55 DB 148	55
				92	122		BSBU-M 55 QB 148	
			105	52	82	MMRS 60-99	BSBU-M 60 DB 148	60
				92	122		BSBU-M 60 QB 148	
240	60	40	140	102	148	MMRS 80-132	BSBU-M 80 DB 210	80
				180	226		BSBU-M 80 QB 210	
				219	265		BSBU-M 80 PB 210	
290	80		170	118	164	MMRS 100-162	BSBU-M 100 DB 256	100
				212	256		BSBU-M 100 QB 256	

Fig. 5.5: IBC precision flange unit BSBU 35 QB 98.M

IBC precision flange units of the BSBU series with their precision bearings that are grease lubricated for life and integrated labyrinth seals can be screwed in easily during mounting through the corresponding locating diameters. In the event of servicing, the ball screw can be drawn out of the machine thanks to these large locating diameters.

Fig. 5.6: IBC precision flange unit BSBU-M 35 QB 128.L with integrated locknut MMRS 35-76

IBC precision flange units of the BSBU-M series have a precision locknut that has been specially developed. The locknut has a long thread with radial locking and a integrated labyrinth seal. The assembly that has been optimized in this way does not need the separate selection and ordering of a locknut.

5.2.2 IBC precision pillow block units - BSPB and BSPB-M series

IBC precision pillow block units of the BSPB series with precision bearings that have been grease-lubricated for life and integrated labyrinth seals can be screwed onto flat areas and fixed by means of predrilled pinholes. The lateral alignment of single- and double-row bearing units achieved done by the close tolerances of the side contact surfaces.

In some combinations of designs and bearings an additional housing for a flange unit is not required and thus provides a space-saving construction.

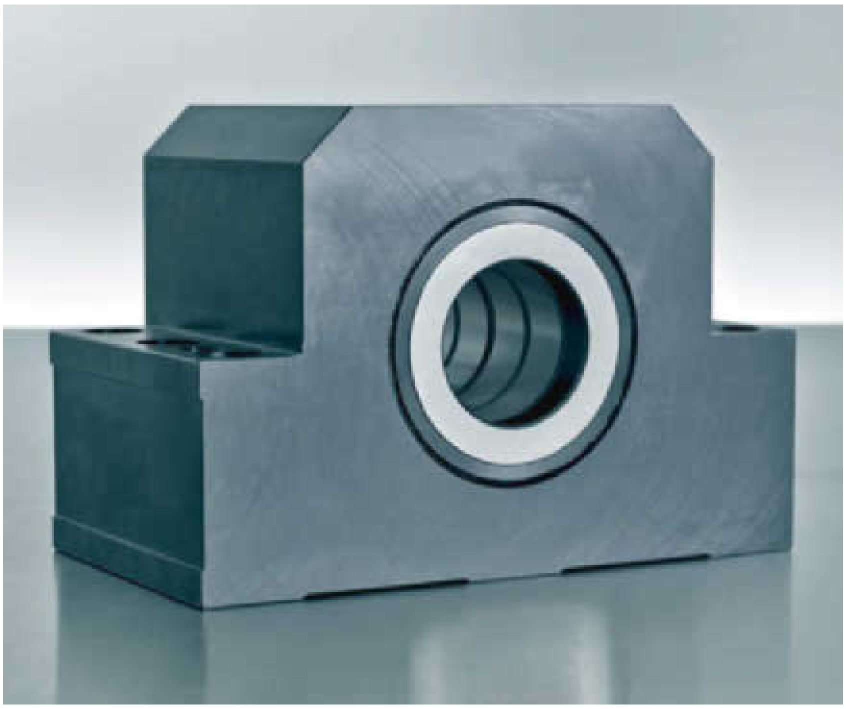


Fig. 5.7: IBC precision pillow block unit of the BSPB series

IBC precision pillow block units of the BSPB series can be supplied with integrated locknuts - series BSPB-M.

As with the precision flange unit in Fig. 5.6, it is not necessary to make a separate selection and ordering of a locknut.

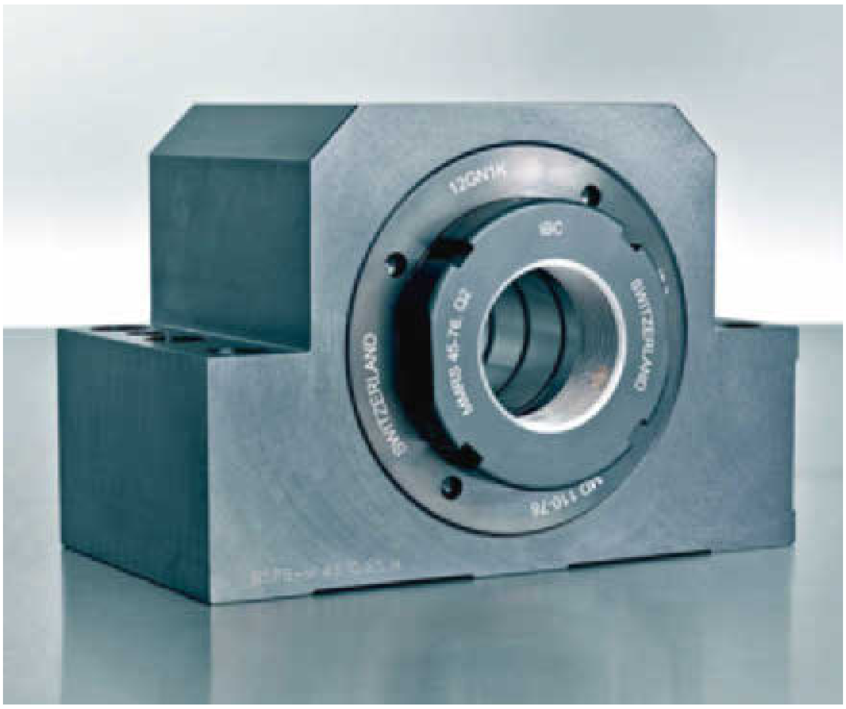
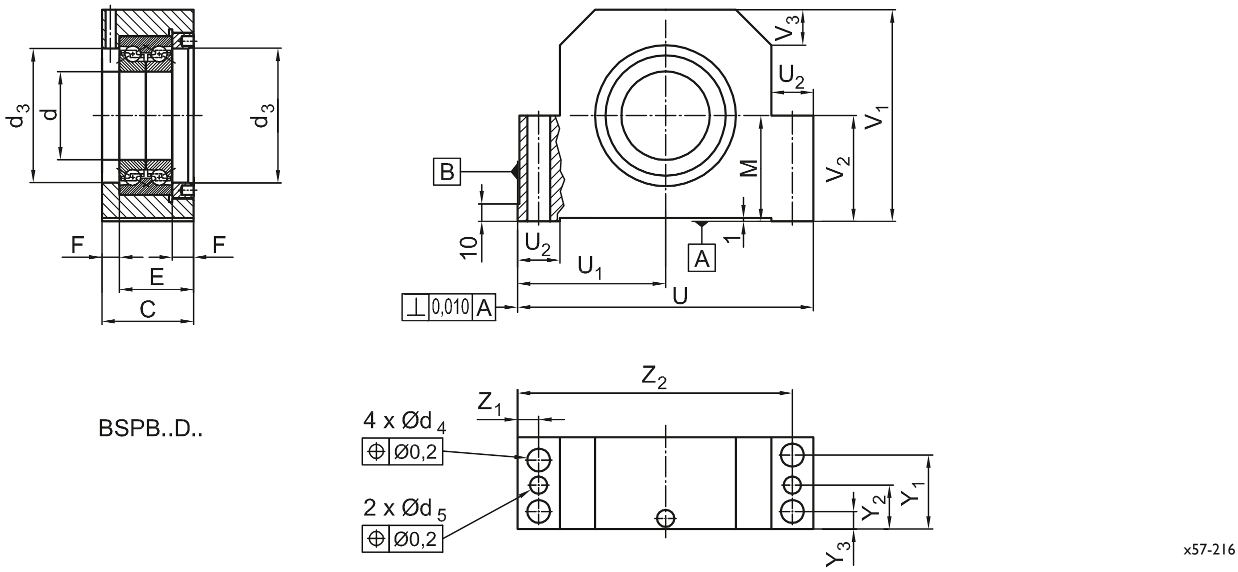


Fig. 5.8: IBC precision pillow block unit with integrated precision locknut BSPB-M series

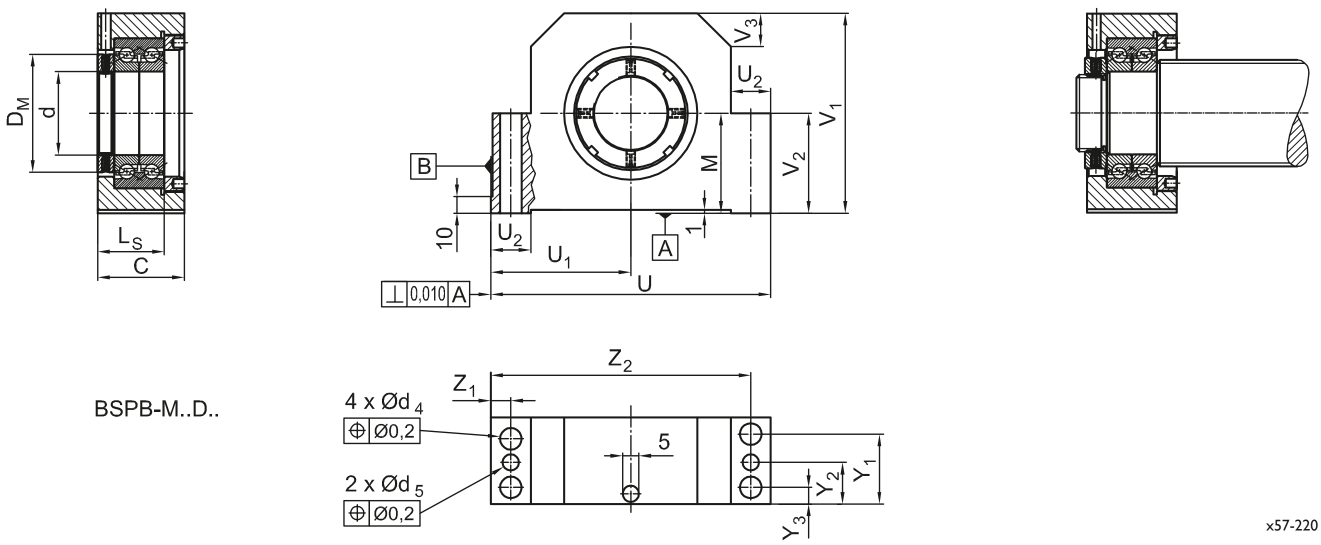
BSPB and BSPB-M series



BSPB..D..

Shaft	Basic designation	d	M	C	E	F	d_3	U	U_1	U_2	V_1	V_2	V_3	Weight
mm		mm												kg
Light series														
10	BSPB 10 D 32 M	10	32	38	29	9	26	86	43	17	55	32	15	0.9
12	BSPB 12 D 32 M	12		43	34			94	47		62			1.2
15	BSPB 15 D 32 M	15												1.7

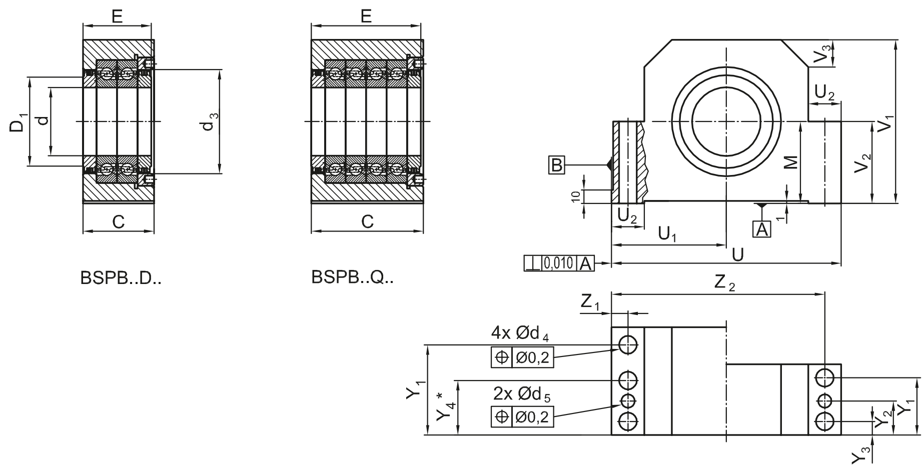
Tolerances: M and U_1 0/-0.02



Y_1	Y_2	Y_3	Z_1	Z_2	d_4	d_s	D_M	L_S	Nut	Integrated bearings	Basic designation	Shaft
				mm								mm
Light series												
30	19	8	8.5	77.5	8.5	7. 8	18	33	MMR 10	BSD 10 M 34.2RSZ.BM	BSPB-M 10 D 32 M	10
34	21.5	9		85.5	9		22		MMR 12	BSD 12 M 42.2RSZ.BM	BSPB-M 12 D 32 M	12
							25		MMR 15	BSD 15 M 45.2RSZ.BM	BSPB-M 15 D 32 M	15

See double-row bearings, BSD series, on page 26 for the load ratings, preloads, stiffness, speeds of rotation and frictional torques

BSPB and BSPB-M series



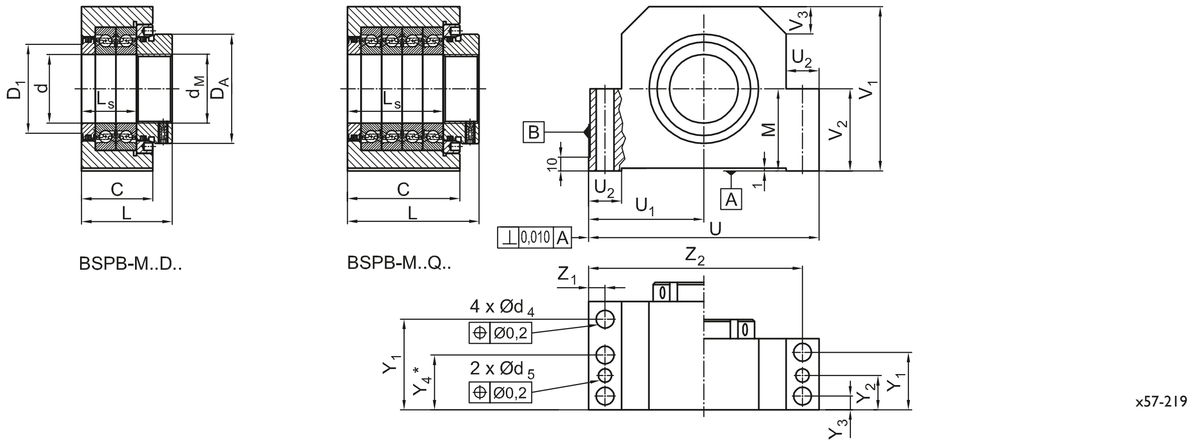
x57-209

Shaft mm	Basic designation	d	M	C	E	d_3	D_1	U	U_1	U_2	V_1	V_2	V_3	Weight kg
		mm												
	Medium series													
17	BSPB 17 D 32	17	32	47	44	36	26	94	47	17	62	32	15	1.5
	BSPB 17 Q 32			77	74									2.6
20	BSPB 20 D 32	20		47	44									1.5
	BSPB 20 Q 32			77	74									2.6
25	BSPB 25 D 42	25	42	52	50	50	40	125	62.5	20	82	42		2.8
	BSPB 25 Q 42			82	80									4.6
30	BSPB 30 D 42	30		52	50									2.7
	BSPB 30 Q 42			82	80									4.5
	BSPB 30 D 50		50	52	50	60	46	136	68	20.5	95	50		3.9
	BSPB 30 Q 50			82	80									6.3
35	BSPB 35 D 50	35		52	50									3.8
	BSPB 35 Q 50			82	80									6.2
40	BSPB 40 D 50	40		52	50		50							3.7
	BSPB 40 Q 50			82	80									6
45	BSPB 45 D 50	45		52	50		55							3.6
	BSPB 45 Q 50			82	80									5.9
55	BSPB 55 D 65	55	65	52	50	76	68	154	77	23	118	65	30	4.5
	BSPB 55 Q 65			82	80									7.2
75	BSPB 75 D 65	75		54	50	99	86	174	87		129			5
	BSPB 75 Q 65			84	80									8
	Heavy series													
35	BSPB 35 D 65	35	65	66	64	76	66	190	95	30	130	65	15	9.7
	BSPB 35 Q 65			106	104									15.9
40	BSPB 40 D 65	40		66	64									9.5
	BSPB 40 Q 65			106	104									15.7
45	BSPB 45 D 65	45		66	64									9.3
	BSPB 45 Q 65			106	104									15.4
50	BSPB 50 D 65	50		66	64									9.1
	BSPB 50 Q 65			106	104									15.1
55	BSPB 55 D 85	55	85	66	64	99	86	200	100		155	85		9.1
	BSPB 55 Q 85			106	104									15.1
60	BSPB 60 D 85	60		66	64									9.1
	BSPB 60 Q 85			106	104									15.1

Tolerances	d	M	U_1	E (Duplex)	E (Quad)
			mm		
BSPB 17 D/Q 32 – BSPB 30 D/Q 42	0 / - 0.005	0 / - 0.013	0 / - 0.013	0 / - 1.02	0 / - 1.52
BSPB 30 D/Q 50 – BSPB 45 D/Q 50		0 / - 0.015	0 / - 0.015		
BSPB 55 D/Q 65 – BSPB 60 D/Q 85	0 / - 0.006	0 / - 0.018	0 / - 0.018		

Technical data see page 50

Recommended locknut MMRB-...from page 78



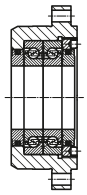
Y_1	Y_2	Y_3	Z_1	Z_2	d_4	d_5	D_A	L_S	L	Integrated locknut see page 84	Basic designation	Shaft mm
mm												
Medium series												
38	22.0	9	8.5	85.5	9	7.8	38	37	57	MMRS 17-36	BSPB-M 17 D 32	17
68								67	87		BSPB-M 17 Q 32	
38								37	57	MMRS 20-36	BSPB-M 20 D 32	20
68								67	87		BSPB-M 20 Q 32	
42	25.0	10	10	115.0	11	9.8	58	40	65	MMRS 25-50	BSPB-M 25 D 42	25
72								70	95		BSPB-M 25 Q 42	
42								40	65	MMRS 30-50	BSPB-M 30 D 42	30
72								70	95		BSPB-M 30 Q 42	
42				126.0	13		70	40	68	MMRS 30-60	BSPB-M 30 D 50	
72								70	98		BSPB-M 30 Q 50	
42								40	68	MMRS 35-60	BSPB-M 35 D 50	35
72								70	98		BSPB-M 35 Q 50	
42								40	68	MMRS 40-60	BSPB-M 40 D 50	40
72								70	98		BSPB-M 40 Q 50	
42								40	68	MMRS 45-60	BSPB-M 45 D 50	45
72								70	98		BSPB-M 45 Q 50	
40.5	26.0	11.5	11.5	142.5			80	40	70	MMRS 55-76	BSPB-M 55 D 65	55
70.5								70	100		BSPB-M 55 Q 65	
40.5				162.5			105	40	70	MMRS 75-99	BSPB-M 75 D 65	75
70.5								70	100		BSPB-M 75 Q 65	
Heavy series												
53	32.0	13	15	175.0	18	11.8	80	52	82	MMRS 35-76	BSPB-M 35 D 65	35
93								92	122		BSPB-M 35 Q 65	
53								52	82	MMRS 40-76	BSPB-M 40 D 65	40
93								92	122		BSPB-M 40 Q 65	
53								52	82	MMRS 45-76	BSPB-M 45 D 65	45
93								92	122		BSPB-M 45 Q 65	
53								52	82	MMRS 50-76	BSPB-M 50 D 65	50
93								92	122		BSPB-M 50 Q 65	
53				185.0			105	52	82	MMRS 55-99	BSPB-M 55 D 85	55
93								92	122		BSPB-M 55 Q 85	
53								52	82	MMRS 60-99	BSPB-M 60 D 85	60
93								92	122		BSPB-M 60 Q 85	

If required, quad units can also be supplied with two additional holes for $Y_4 = Y_1$ of duplex units

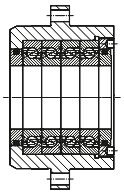
Bearing units BSPB(-M) 80D; Q; P 115 and BSPB(-M) 100D; Q; P 140 on request

Units with a locating edge on both sides Q 51 on request

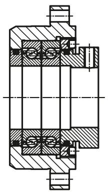
5.2.3 Technical data
IBC precision flange and pillow block units, symmetrical bearing arrangement DB and QB



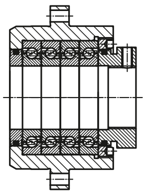
BSBU...DB...



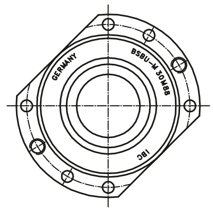
BSBU...QB...

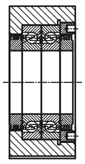


BSBU-M...DB...

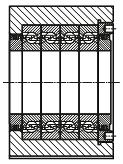


BSBU-M...QB...

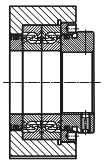




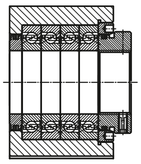
BNBU...DB...



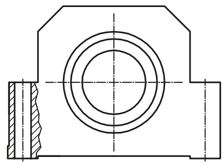
BNBU...QB...



BSPB-M...D...



BSPB-M...Q...



x57-233

Basic designation		Load rating axial		Preload F_v			Axial stiffness S_{ax}			Speed grease n_{Grease}			Starting frictional torque M_r		
BSBU BSBU-M	BSPB BSPB-M	C_a	C_{oa}	L	M	H	L	M	H	L	M	H	L	M	H
		N			N			N/µm			min^{-1}			Nm	
Duplex series medium series															
BSBU 17 DB 64	BSPB 17 D 32	25,200	33,800	850	1,910	3,820	530	710	900	8,800	7,100	3,600	0.06	0.09	0.18
BSBU 20 DB 64	BSPB 20 D 32														
BSBU 25 DB 88	BSPB 25 D42	30,400	49,800	1,250	2,810	5,620	720	950	1,210	6,400	5,200	2,600	0.12	0.19	0.37
BSBU 30 DB 88	BSPB 30 D 42														
BSBU 30 DB 98	BSPB 30 D 50	32,900	62,100	1,550	3,490	6,980	880	1,160	1,480	5,200	4,200	2,100	0.18	0.29	0.57
BSBU 35 DB 98	BSPB 35 D 50														
BSBU 40 DB 98	BSPB 40 D 50														
BSBU 45 DB 98	BSPB 45 D 50	44,300	85,700	1,710	3,850	7,700	900	1,190	1,510	5,000	4,000	2,000	0.20	0.32	0.64
BSBU 55 DB 113	BSPB 55 D 65	47,900	105,600	2,110	4,750	9,500	1,090	1,450	1,840	4,000	3,200	1,600	0.30	0.49	0.97
BSBU 75 DB 138	BSPB 75 D 65	52,000	134,000	2,690	6,050	12,100	1,150	1,530	1,940	3,200	2,500	1,200	0.52	0.82	1.65
Duplex series heavy series															
BSBU 35 DB 128	BSPB 35 D 65	67,900	133,000	3,330	7,490	14,980	1,270	1,680	2,140	4,000	3,200	1,600	0.46	0.73	1.47
BSBU 40 DB 128	BSPB 40 D 65														
BSBU 45 DB 128	BSPB 45 D 65														
BSBU 50 DB 128	BSPB 50 D 65	69,200	140,000	2,800	6,300	12,600	1,230	1,630	2,070	3,800	3,000	1,500	0.20	0.33	0.65
BSBU 55 DB 148	BSPB 55 D 85	86,200	189,500	3,790	8,530	17,060	1,400	1,850	2,360	3,200	2,500	1,200	0.62	0.99	1.98
BSBU 60 DB 148	BSPB 60 D 85														
BSBU 80 DB 210	BSPB 80 D 115	189,600	275,400	5,510	12,400	24,800	840	1,120	1,440	2,400	1,900	900	1.23	1.96	3.92
BSBU 100 DB 256	BSPB 100 D 140	167,400	309,400	6,190	13,930	-	1,170	1,570	-	1,800	1,400	-	1.06	1.70	-
Quad series medium series															
BSBU 17 QB 64	BSPB 17 Q 32	40,900	67,600	1,700	3,820	7,640	1,060	1,420	1,800	6,100	4,800	2,400	0.11	0.18	0.36
BSBU 20 QB 64	BSPB 20 Q 32														
BSBU 25 QB 88	BSPB 25 Q 42	49,300	99,600	2,500	5,620	11,240	1,440	1,900	2,420	4,400	3,500	1,800	0.23	0.37	0.75
BSBU 30 QB 88	BSPB 30 Q 42														
BSBU 30 QB 98	BSPB 30 Q 50	53,500	124,000	3,100	6,980	13,960	1,760	2,320	2,960	3,600	2,900	1,400	0.36	0.57	1.14
BSBU 35 QB 98	BSPB 35 Q 50														
BSBU 40 QB 98	BSPB 40 Q 50														
BSBU 45 QB 98	BSPB 45 Q 50	71,800	171,400	3,420	7,700	15,400	1,800	2,380	3,020	3,400	2,700	1,300	0.40	0.64	1.28
BSBU 55 QB 113	BSPB 55 Q 65	77,600	211,200	4,220	9,500	19,000	2,180	2,900	3,680	2,800	2,200	1,100	0.61	0.97	1.94
BSBU 75 QB 138	BSPB 75 Q 65	84,200	268,800	5,380	12,100	24,200	2,300	3,060	3,880	2,200	1,700	800	1.03	1.65	3.30
Quad series heavy series															
BSBU 35 QB 128	BSPB 35 Q 65	110,200	266,000	6,660	14,980	29,960	2,540	3,360	4,280	2,700	2,200	1,100	0.92	1.47	2.94
BSBU 40 QB 128	BSPB 40 Q 65														
BSBU 45 QB 128	BSPB 45 Q 65														
BSBU 50 QB 128	BSPB 50 Q 65	112,300	280,000	5,600	12,600	25,200	2,460	3,260	4,140	2,600	2,000	1,000	0.82	1.31	2.62
BSBU 55 QB 148	BSPB 55 Q 85	139,600	379,000	7,580	17,060	34,120	2,800	3,700	4,720	2,200	1,700	800	1.24	1.98	3.96
BSBU 60 QB 148	BSPB 60 Q 85														
BSBU 80 QB 210	BSPB 80 Q 115	307,900	550,800	11,020	24,800	49,600	1,680	2,240	2,880	1,600	1,300	600	2.45	3.92	7.84
BSBU 100 QB 256	BSPB 100 Q 140	272,000	618,800	12,380	27,860	-	2,340	3,140	-	1,200	900	-	2.13	3.40	-

5.2.4 Technical data
IBC precision flange and pillow block units, asymmetrical bearing arrangement

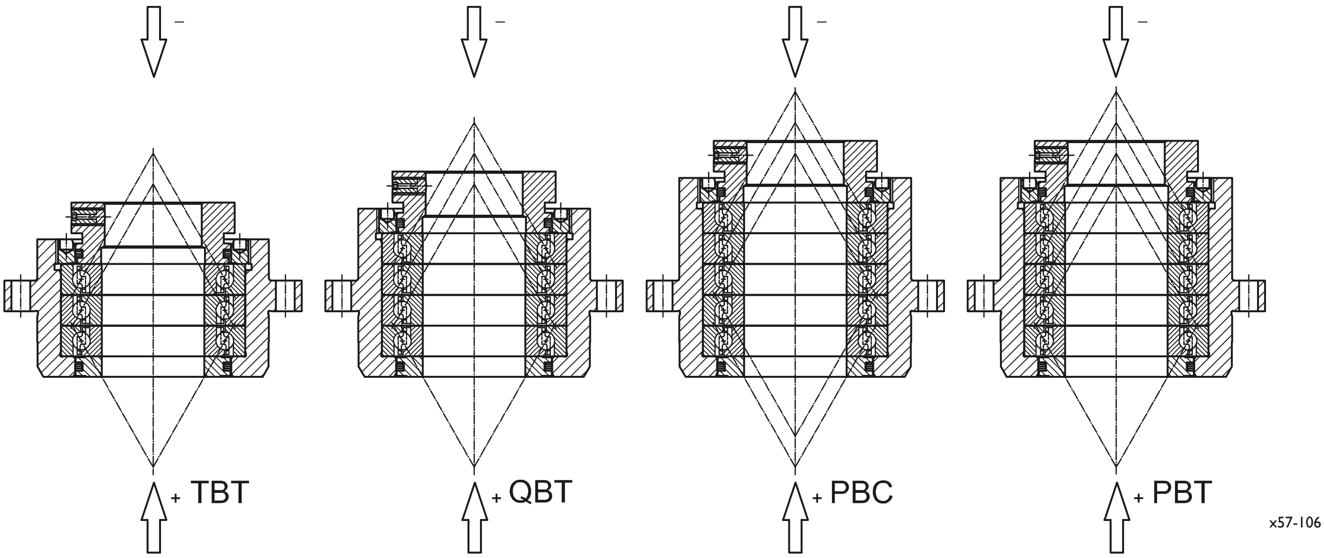


Fig. 5.9: Asymmetric bearing arrangements for ball screws that are loaded primarily on one side

In addition to symmetrically loaded feed axes, in many machine tools such as millers and drills there are also asymmetrically loaded axes which primarily have to take up the forces in one loading direction. This applies in particular to vertical axes that drive the heavy tables of ball screws or to horizontal axes in which the machining advance feed is always in only one direction (drilling, deep drilling).

Precision 60° ball screw support bearings or complete flange and pillow block units with asymmetrical bearing arrangements have proven their worth for these application cases.

In axes that are loaded asymmetrically the preloading of the bearing F_v should be selected to be such that it or the counterpart bearing(s) are not unloaded. For simplicity, the main factors for determining the dynamic and static axial load rating C_a and C_{oa} and the factor X for the unloading in both directions is summarized in the following (Table 5.1).

The limiting speed values for individual bearings are listed in the tables on pages 22 and 23. In the case of precision bearing sets for bearing arrangements TBT, QBT, PBC and PBT the values for the limiting speeds can be multiplied by the rotation speed factors shown below.

Bearing arrangement			**Load rating factors**				**Unloading from X · F_v factor**		**Rotation speed factor**
			dynamic		**static**				
			C_{aA}	C_{aB}	C_{oaA}	C_{oaB}	X für A	X für B	
DB	<>	AB	1	1	1	1	2.83	2.83	0.8
TBT	<<>	AAB	1.62	1	2	1	5.66	2.83	0.65
QBT	<<<>	AAAB	2.12	1	3	1	8.49	2.83	0.6
PBC	<<<>>	AAABB	2.12	1.62	3	2	8.49	5.66	0.35
PBT	<<<<>	AAAAB	2.64	1	4	1	11.3	2.83	0.45

Table 5.1: Load rating, unloading and speed factors for asymmetric bearing arrangements

5.3 IBC precision floating bearing units - BLBU and BLPB series

Fig. 5.10: IBC precision floating bearing unit of the BLBU series

Precision bearing units of flange and pillow block configuration consist of a both-side sealed needle roller bearing that assumes the function of a floating bearing. This produces the axial movement within the rolling bearing and not via the fit. Thanks to a bearing system with an IBC precision floating bearing unit, the whirling of the spindle end at higher speeds of rotation is prevented. The axial stiffness is not increased when using a floating bearing unit. This can be attained by the use of spring-preloaded or locating-locating bearing combinations.

IBC precision pillow block floating bearings are produced with the same close-tolerance centre heights M and mounting dimension U_1 as in precision locating bearing units of the BSPB series. This permits rapid mounting at a locating edge. The bearing clearance of the precision flange and precision pillow block units are in accordance with the tolerances of DIN 620-4 CN. We recommend spring-preloaded assemblies (see page 94) for cases with tighter requirements and also to increase the critical speed of rotation. The table on page 54 shows the most important mounting dimensions.

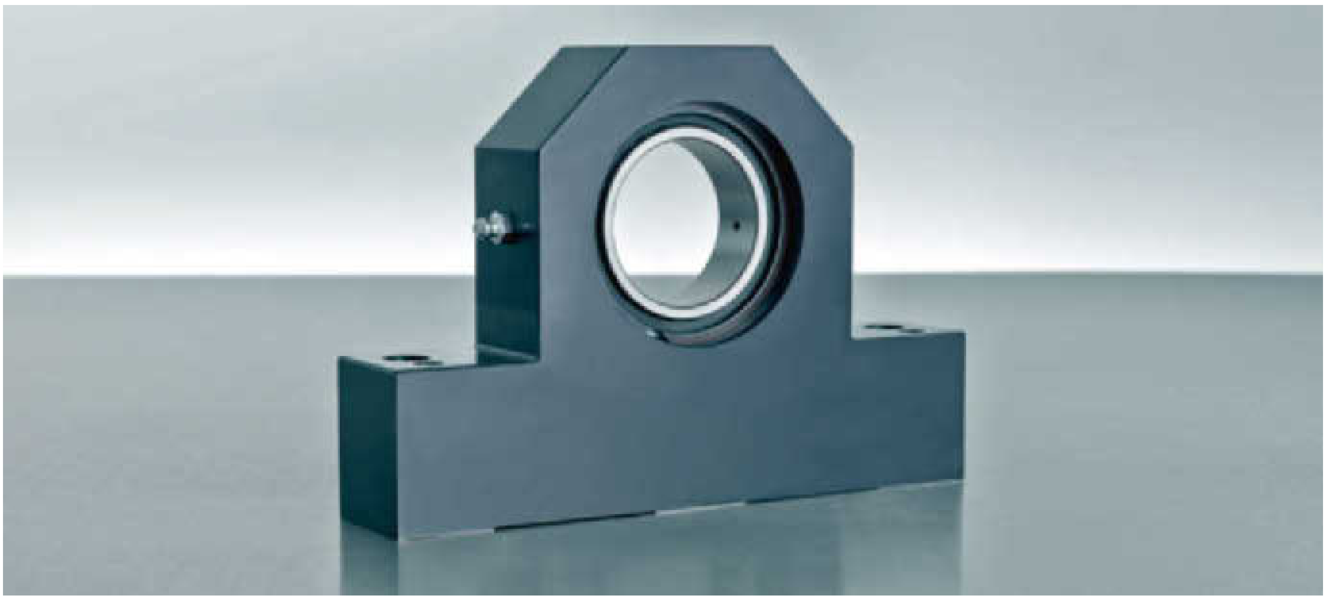
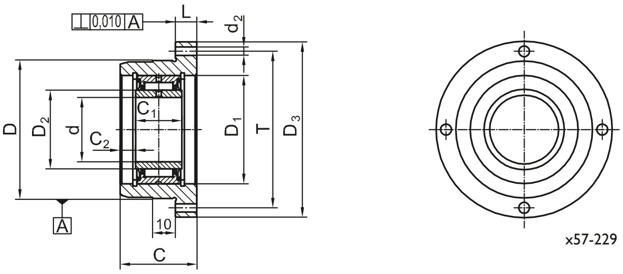


Fig. 5.11: IBC precision floating bearing unit of the BLPB series

IBC precision flange - floating bearing units for spindle ends BLBU...N...2RS

Radial bearing clearance CN in accordance with DIN 620 - 4			
Bore d		CN	
mm		µm	
over	up to	min.	max.
-	30	20	45
30	40	25	50
40	50	30	60

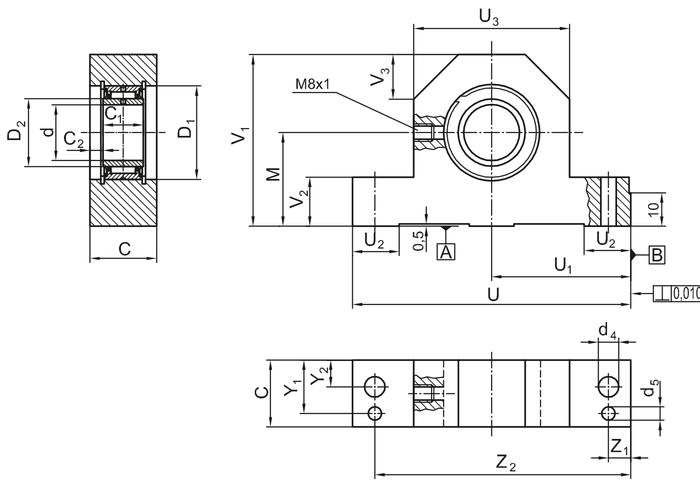


x57-229

Shafts	Basic designation	d	D	ΔD	C	C_1	C_2	D_1	D_2	D_3	L	T	d_2	n_{Grease}	C	C_0
mm		mm												min^{-1}	N	
10	BLBU 10 N 32	10	32	0 / -0.013	25	14	5.5	22	14	52	6	42	4.5	13,000	6,800	6,900
12	BLBU 12 N 35	12	35					24	16	55		45		12,000	7,600	8,300
17	BLBU 17 N 40	17	40		26		6	30	20	60		50		9,000	8,800	11,000
20	BLBU 20 N 50	20	50		30	18		37	25	70	8	60		7,500	17,300	19,900
25	BLBU 25 N 55	25	55					42	30	75		65		6,500	19,300	24,200
30	BLBU 30 N 60	30	60		32			47	35	80		70		5,500	21,100	28,500
35	BLBU 35 N 70	35	70		38	21	8.5	55	42	90	10	80	5.5	4,800	26,500	39,500
40	BLBU 40 N 80	40	80		43	23	10	62	48	110		95		4,200	36,000	53,000
45	BLBU 45 N 85	45	85	0 / -0.015				68	52			98		3,900	38,000	59,000
50	BLBU 50 N 90	50	90		44		10.5	72	58	120		105		3,500	40,000	64,000

IBC precision pillow block - floating bearing units for spindle ends BLPB...N...2RS

Tolerances	M	U_1	ΔD
	mm		
BLPB 10 N 32	0 / -0.013	0 / -0.013	0 / -0.013
BLPB 20 N 32			
BLPB 25 N 42			
BLPB 30 N 50	0 / -0.015	0 / -0.015	
BLPB 40 N 65	0 / -0.018	0 / -0.018	
BLPB 50 N 65			0 / -0.015

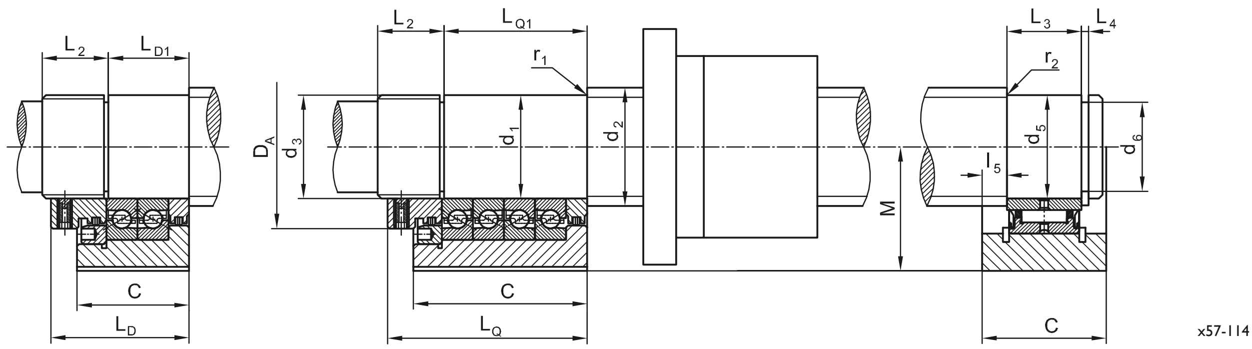


x57-230

Shafts	Basic designation	d	M	C	C_1	C_2	D_1	D_2	U	U_1	U_2	U_3	V_1	V_2	V_3	Y_1	Y_2	Z_1	Z_2	d_4	d_5	C	C_0
mm		mm																				N	
10	BLPB 10 N 32	10	32	26	14	6	22	14	86	43	16	46	50	15	12	19.0	8	8.5	77.5	9	5.8	6,800	6,900
12	BLPB 12 N 32	12					24	16	94	47		56	59		15	21.5	9		85.5			7,600	8,300
17	BLPB 17 N 32	17					30	20														8,800	11,000
20	BLPB 20 N 32	20		30	18		37	25								24,0	12					17,300	19,900
25	BLPB 25 N 42	25	42				42	30	125	62.5	21	70	77	22	20			10	115			19,300	24,200
30	BLPB 30 N 50	30	50				47	35	136	68		80	88	28					126			21,100	28,500
40	BLPB 40 N 65	40	65	40	23	8.5	62	48	190	95	30	100	108	38		30.0	15	15	175	13	7.8	36,000	53,000
50	BLPB 50 N 65	50					72	58														40,000	64,000
	BLPB 50 N 85		85						200	100		110	138	48	30				185				

The limiting speed n_{Grease} and the radial bearing clearance CN of the BLPB series correspond to those of the BLBU series in the above tables

5.4 Component dimensions of the ball screw spindles for IBC precision flange and pillow block units, locating and floating bearings



Basic designation*	d_1	d_2	d_3 4h/6h	D_A	L_D	L_{D1}	L_Q	L_{Q1}	L_2	r_{1max}	M	d_5 j5	d_6 h11	L_3	L_4	l_5	r_{2max}	Basic designation
Locating bearings												Floating bearings						
	mm																	
Medium series																		
BSPB-M 17 D 32	17	23	M 17 x 1	38	57	36	87	65	24	0.5	32	20	19.2	18	1.2	6	0.3	BLPB 20 N 32
BSPB-M 20 D 32	20	26	M 20 x 1															
BSPB-M 25 D 42	25	35	M 25 x 1.5	58	65	39	95	68	29	0.8	42	25	24					BLPB 25 N 42
BSPB-M 30 D 42	30	37	M 30 x 1.5															
BSPB-M 30 D 50				70	68		98		32		50	30	29		1.5			BLPB 30 N 50
BSPB-M 35 D 50	35	42	M 35 x 1.5															
BSPB-M 40 D 50	40	47	M 40 x 1.5															
BSPB-M 45 D 50	45	53	M 45 x 1.5															
BSPB-M 55 D 65	55	63	M 55 x 2	80	70		100		34		65	50	48.5	23		8.5	0.6	BLPB 50 N 85
BSPB-M 75 D 65	75	84	M 75 x 2	105														
Heavy series																		
BSPB-M 35 D 65	35	43	M 35 x 1.5	80	82	51	122	90	34	0.8	65	40	38.5	23	1.5	8.5	0.6	BLPB 40 N 65
BSPB-M 40 D 65	40	48	M 40 x 1.5															
BSPB-M 45 D 65	45	54	M 45 x 1.5															
BSPB-M 50 D 65	50	59	M 50 x 1.5															
BSPB-M 55 D 85	55	65	M 55 x 2	105							85	50	48.5					BLPB 50 N 85
BSPB-M 60 D 85	60	70	M 60 x 2															

The same mounting dimensions as for precision pillow block units apply to the following precision flange units:

Medium series		Tolerance d_1 [µm]
BSBU-M 17 D 64	BSPB-M 17 D 32	-3 / -7
BSBU-M 20 D 64	BSPB-M 20 D 32	
BSBU-M 25 D 88	BSPB-M 25 D 42	
BSBU-M 30 D 88	BSPB-M 30 D 42	
BSBU-M 30 D 98	BSPB-M 30 D 50	-4 / -8
BSBU-M 35 D 98	BSPB-M 35 D 50	
BSBU-M 40 D 98	BSPB-M 40 D 50	
BSBU-M 45 D 98	BSPB-M 45 D 50	
BSBU-M 55 D 113	BSPB-M 55 D 65	-4 / -9
BSBU-M 75 D 138	BSPB-M 75 D 65	
Heavy series		**Tolerance d_1 [µm]**
BSBU-M 35 D 128	BSPB-M 35 D 65	-4 / -8
BSBU-M 40 D 128	BSPB-M 55 D 85	
BSBU-M 45 D 128	BSPB-M 45 D 65	
BSBU-M 50 D 128	BSPB-M 50 D 65	
BSBU-M 55 D 148	BSPB-M 55 D 85	-4 / -9
BSBU-M 60 D 148	BSPB-M 60 D 85	

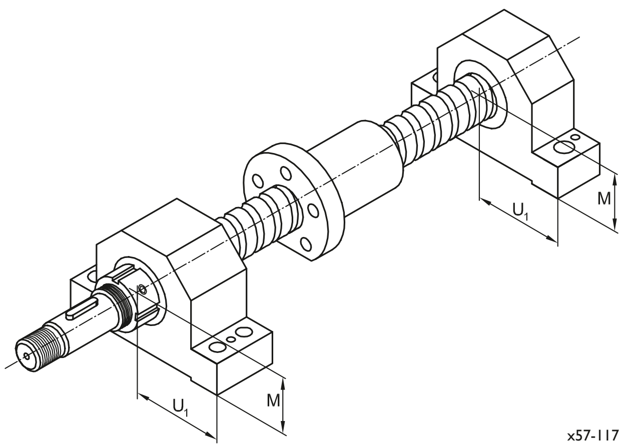


Fig. 5.12: The same reference dimensions (U_1, M) for precision locating and floating bearing units simplify mounting

** For simplicity, only the duplex units are listed here. The above mounting dimensions in accordance with the table and drawing apply to the quadruplex sets*

5.5 IBC precision bearing units for driven ball screw nuts of ball screws

Driven spindle nuts in ball screws have the following advantages:

- With long spindles the mass to be accelerated is reduced when the spindle nut is driven.
- The spindle can be preloaded without additional forces being applied to the bearing. This means that both the stiffness and the critical speed of the spindle can be increased.

Ball screw manufacturers produce ball screw nuts with a centering in front of or behind the flange for this purpose.

IBC offers the following two configurations:

- BNBU-flange units
- BNPB-pillow block units

The standard bearing units of the BNBU and BNPB series allow simple mounting of the ball screw nut and the base frame simultaneously due to the matched adapter.

Adapter sleeves with an enlarged mounting flange can also be used with ball screw nuts with a locating flange on the short side (preferred for ball screw nut bearings). Here the precision 60° ball screw support bearings are located radially closer to the ball screw spindle and axially before the ball screw nut. This allows rolling bearings of a smaller diameter to be used and hence to be run at higher speeds. On the other hand, this entails a slightly longer construction than for a standard unit placed radially to the ball screw nut.

Precision bearing units with rotary through feed for lubrication of the ball screw nut

IBC also offers precision bearing units with rotary through feed for lubrication of the ball screw nut. The lubrication of the ball screw nut by means of an IBC precision bearing unit is an convenient and compact solution, since grease or oil can be applied to the ball screw nut via the bearing unit. Regardless of the duration of the machining cycles, this ensures that the ball screw nut is always lubricated. Previously the ball screw nut had to be introduced into the end and lubricating position of a hollow-drilled spindle to be repeatedly given a lubrication pulse there. The new solution markedly reduces the machining time for a work piece.

Versions with a rotary through feed for lubrication of the ball screw nut are marked with the additional designation S - BNBUS and BNPBS. Please contact our technical department for precision bearing units with lubrication of the ball screw nut with multiple precision 60° ball screw support bearings.

Precision bearing units with rotary through feed for an adapter sleeve with optimized connecting flange

IBC precision bearing units of the BNBU and BNPB series are characterized by the adapter sleeve with optimized mounting flange, a recess in the rotary through feed area. This gives the option to make use of smaller precision bearing units in the diameter. The bearing units are installed axially in front of the ball screw nut instead of radially at the ball screw nut. The following showes some corresponding examples.

Fig. 5.13: IBC precision flange unit, BNBU series

Fig. 5.14:: IBC precision flange unit, BNBUS series

5.5.1 IBC precision flange units for driven ball screw nuts - BNBU series

With long ball screws it is advantageous to drive the nut of the ball screw so as to reduce the driven mass. Here precision bearing units of the BNBU series with grease lubrication in which the ball screw support bearings have already been preloaded with an adapter sleeve have proven their worth. The matching thread hole pattern to attach the flange of the ball screw nut is integrated into this adapter sleeve, as is also the required location for the ball screw nut.

The ball screw nut only needs to be introduced and screwed into the adapter sleeve, which enables an efficient mounting. Standard nut bearing units according to the following tables are offered for ball screw nominal diameter d_o and the associated pitch P.

In the case of ball screw nuts that deviate from the standard the stated mounting characteristics must be discussed with the technical department of IBC.

Units with integrated rotary through feed for lubrication of the ball screw nut can only be used with the …QB…housing and with a DB arrangement of the bearings, and in special cases with a TBT arrangement, due to the extra amount of space required internally. Applications involving a greater axial load should be discussed with the technical department of IBC.

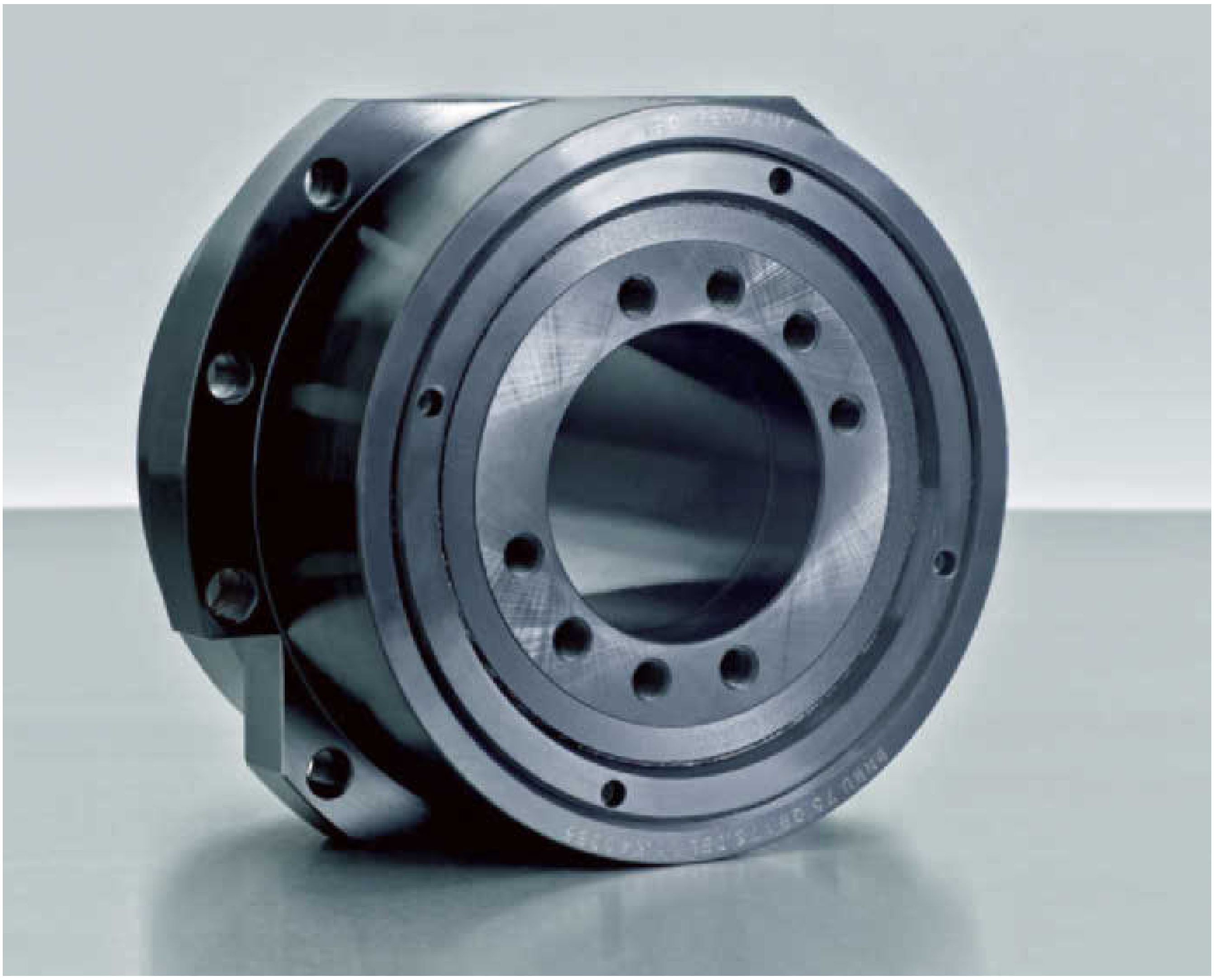
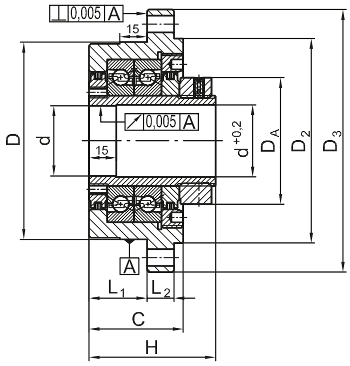
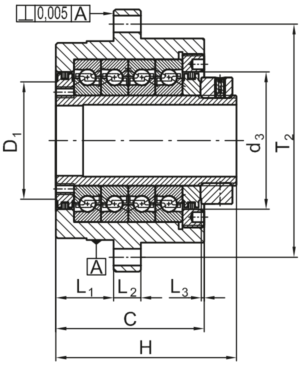


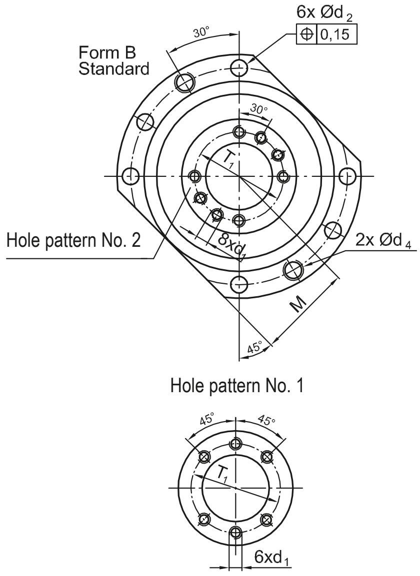
Fig. 5.15: IBC precision flange unit for ball screw spindle nut BNBU 75 QB 178.2.DBL.M1



BNBU...DB...



BNBU...QB...



d57-202

Hole pattern number 1 and 2 for the direct flange mounting
of ball screw nuts in accordance with DIN 69051 for ball screws
(Adapter for other ball screw nuts on request)

BS d_0 x P	**Basic designation**	**d**	**D**	**M**	**C**	**H**	d_1	d_2	d_3	d_4	D_A	D_1	D_2	D_3	T_1	T_2	L_1	L_2	L_3	**Hole pattern**
		mm																		
16 x 5	BNBU 28 DB 98	28	98	49	52	70	M5	9.2	67	M12	65	60	98	130	38	113	32	15	2	1
20 x 5	BNBU 36 DB 98	36					M6								47					
25 x 5	BNBU 40 DB 113	40	113	56.5					76		75	68	113	145	51	129				
25 x 10	BNBU 40 QB 113				82	100														
32 x 5	BNBU 50 DB 138	50	138	69	54	70	M8		99		98	86	138	170	65	154			4	
32 x 10	BNBU 50 QB 138				84	100														
40 x 5	BNBU 63 DB 138	63			54	70									78					2
40 x 10	BNBU 63 QB 138				84	100														
50 x 5	BNBU 75 DB 178	75	178	89	77	101	M10	11.4	132	M14	130	142	178	215	93	197	50	20		
50 x 10	BNBU 75 QB 178				122	146														
63 x 5	BNBU 90 DB 210	90	210	105	77	105			161		160	144	210	248	108	230				
63 x 10	BNBU 90 QB 210				122	150														
63 x 20	BNBU 95 DB 210	95			77	105	M12								115					
	BNBU 95 QB 210				122	150														
80 x 10	BNBU 105 DB 210	105			77	105									125					
	BNBU 105 QB 210				122	150														

See page 61 for technical data

Tolerance **Housing**	**d**	**D**
	mm	
BNBU 28 DB/QB 98 – BNBU 36 DB/QB 98	+ 0.003 / - 0.010	0 / - 0.015
BNBU 40 DB/QB 113 – BNBU 105 DB/QB 210		0 / - 0.018

Adapters with another d, hole pattern and configuration on request

For precision bearing units with built-in lubrication for the ball screw nut (series BNBUS) there are separate data sheets available.

IBC also produces on request precision special bearing units with adapter sleeve with optimized mounting flange for the ball screw nut, see Fig. 5.16 on page 58 and the following pages.

5.5.2 IBC precision flange units for driven ball screw nuts - BNBUS series

In IBC precision bearing units of the BNBU, BNPB and BNPBS series the adapter sits radially above the ball screw nut on a centering behind the attachment flange of the ball screw nut. This solution is very compact in the axial direction but requires relatively large bearings, because they are larger than the outer diameter of the ball screw nut. The bearing units can be used for normal applications with moderate speeds of rotation and adequate space.

IBC precision flange units of the BNBUS series were developed for the bearings of ball screw nuts for applications involving higher speeds of rotation and with the same diameter as the ball screw. In these flange units the adapter sleeve has an optimised connecting flange, on the front side of which the ball screw nut is located.

As a result, the inner diameter of the adapter sleeve can be reduced to almost that of the nominal diameter of the spindle. This allows smaller bearings to be used, which permit significantly higher speeds.

A rotary through feed to lubricate the ball screw nut has already been built into the optimized connecting flange of the adapter sleeve.

The bearing units were designed in the first instance for a bearing pair. Under higher loads, these can also be produced in lengthened form with a greater number of rolling bearings.

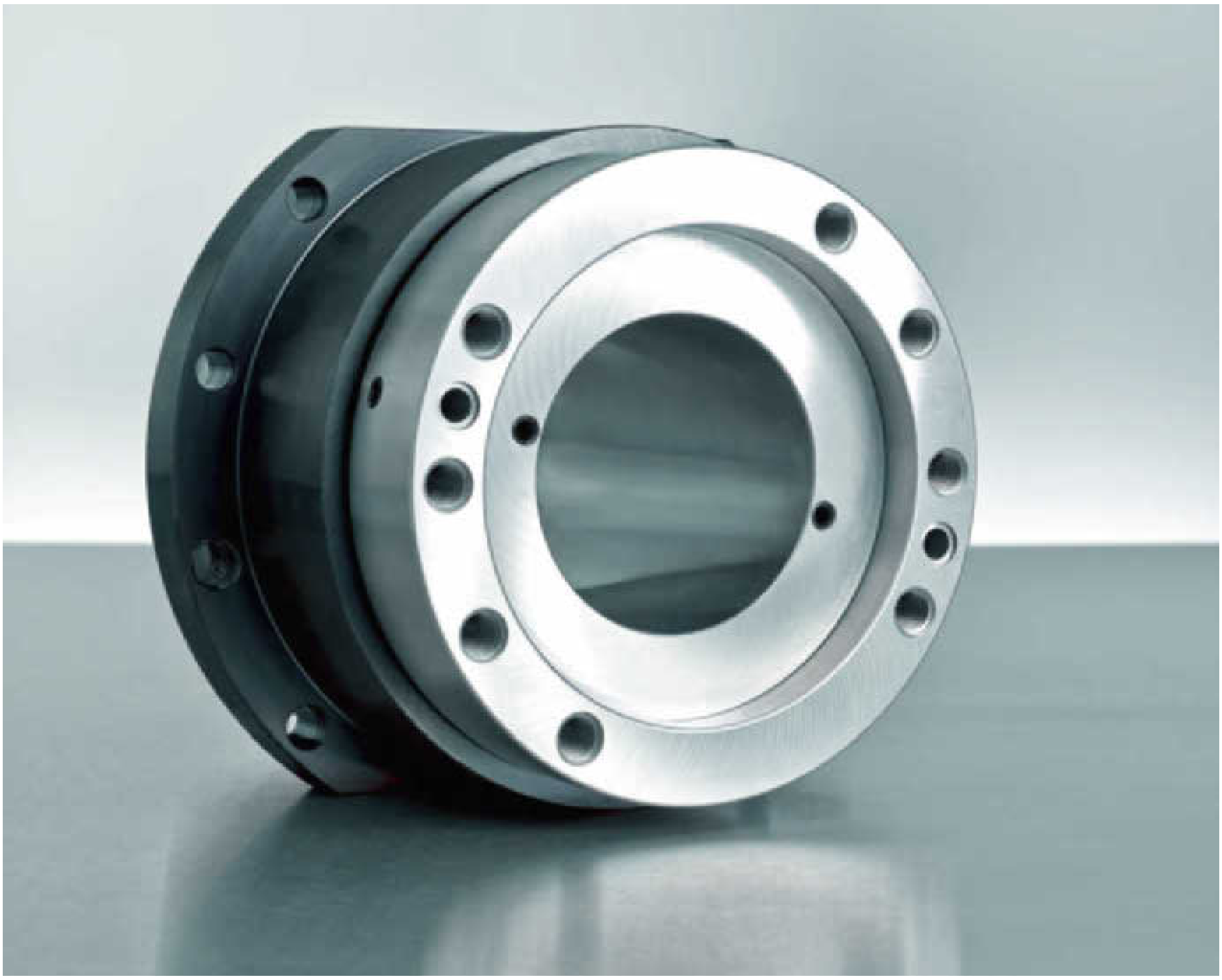
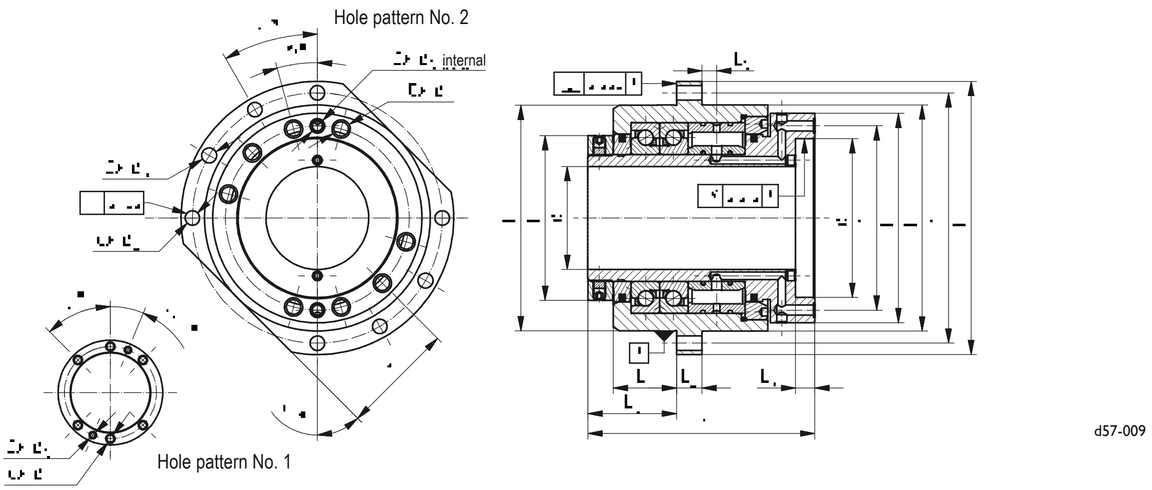


Fig. 5.16:: IBC precision flange unit for driven ball screw nuts with lubrication through feed and adapter sleeve with optimised mounting flange BNBUS 81/125 QB 178.DBM.M1 as the bearings for a ball screw



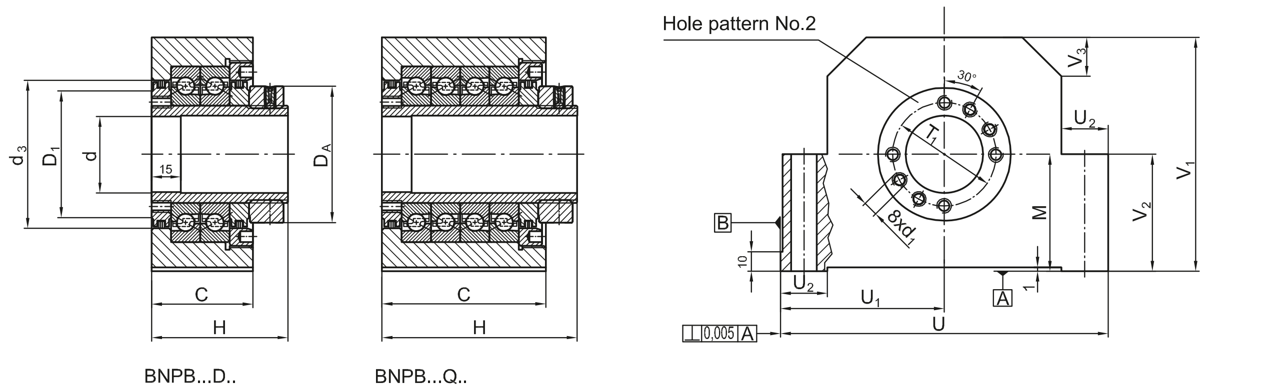
BS d_0 x P	Basic designation	d	d_z	D	M	d_1	d_2	d_4	d_5	D_1	D_2	D_3	D_4	T_1	T_2	L_1
		mm														
32 x 15 32 x 20	BNBUS 33/56 QB 113.DB_.M1	33	56	113	56.5	M6	9.2	M12	8	80	113	145	86	71	129	32
40 x 20 40 x 25	BNBUS 51/70 QB 138.DB_.M1	51	70	138	69	M8				105	138	170	100	85	145	
50 x 15 50 x 20 50 x 25 50 x 30	BNBUS 51/82 QB 138.DB_.M1	51	82			M10							118	100		
63 x 15 63 x 20 63 x 25 63 x 30 63 x 40	BNBUS 78/95 QB 178.DB_.M1	78	95	178	89	M12	11.4	M14		140	178	215	135	115	197	50
80 x 20 80 x 30 80 x 40	BNBUS 81/125 QB 178.DB_.M1	81	125										165	146		

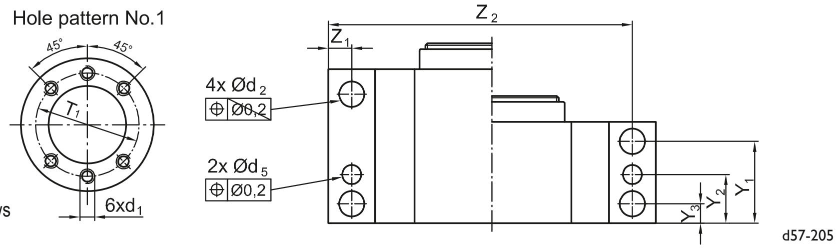
BS d_0 x P	Basic designation	L_2	L_3	L_4	L_5	H	Tolerance d_z	Tolerance D	Hole pattern	Weight	Basic designation Precision 60° ball screw support bearings
		mm								kg	
32 x 15 32 x 20	BNBUS 33/56 QB 113.DB_.M1	15	51	10.2	8	134	+ 0.005 / - 0.008	0 / - 0.018	1	7	BS 55 M 90
40 x 20 40 x 25	BNBUS 51/70 QB 138.DB_.M1		53			136	+ 0.005 / - 0.009		2	10	BS 75 M 110
50 x 15 50 x 20 50 x 25 50 x 30	BNBUS 51/82 QB 138.DB_.M1									11	
63 x 15 63 x 20 63 x 25 63 x 30 63 x 40	BNBUS 78/95 QB 178.DB_.M1	20	71		11.5	179				20	BS 100 M 150
80 x 20 80 x 30 80 x 40	BNBUS 81/125 QB 178.DB_.M1		70	15.2		179	+ 0.007 / - 0.010			21	

The preload (L, M or H) is shown at the position of the underscore

Further adapters on request

5.5.3 IBC precision pillow block units for driven ball screw nuts – BNPB and BNPBS series





Hole pattern number 1 and 2 for the direct flange mounting of ball screw nuts in accordance with DIN 69051 for ball screws (adapters for other ball screw nuts on request)

BS d_0 x P	Basic designation	d	M	C	H	d_1	*d_3	d_4	d_5	D_1	D_A	T_1	U	U_1	U_2	V_1	V_2	V_3	Y_1	Y_2	Y_3	Z_1	Z_2	Hole pattern
		mm																						
16 x 5	BNPB 28 D 50	28	50	52	70	M5	67	13	9.8	55	65	38	136	68	20.5	98	50	20	42	25.0	10	10	126.0	1
20 x 5	BNPB 36 D 50	36				M6						47												
25 x 5	BNPB 40 D 65	40	65				76			68	75	51	154	77	23.0	118	65		40.5	26.0	11.5	11.5	145.2	
25 x 10	BNPB 40 Q 65			82	100														70.5					
32 x 5	BNPB 50 D 65	50		54	70	M8	99			89	98	65	174	87		129			40.5				162.5	
32 x 10	BNPB 50 Q 65			84	100														70.5					
40 x 5	BNPB 63 D 65	63		54	70							78							40.5					2
40 x 10	BNPB 63 Q 65			84	100														70.5					
50 x 5	BNPB 75 D 85	75	85	77	101	M10	132	18	11.8	114	130	93	230	115	30	170	85	30	57	37.0	17	15	215.0	
50 x 10	BNPB 75 Q 85			122	146														100					
63 x 5	BNPB 90 D 105	90	105	77	105		161	21		140	160	108	280	140	35	207	105	50	57			17	263.0	
63 x 10	BNPB 90 Q 105			122	150														100					
63 x 20	BNPB 95 D 105	95		77	105	M12						115							57					
	BNPB 95 Q 105			122	150														100					
80 x 10	BNPB 105 D 105	105		77	105							125							57					
	BNPB 105 Q 105			122	150														100					

** For preference, tightened up with cylinder head screws in accordance with DIN 912, strength class 8.8 or higher.*
Further configurations on request

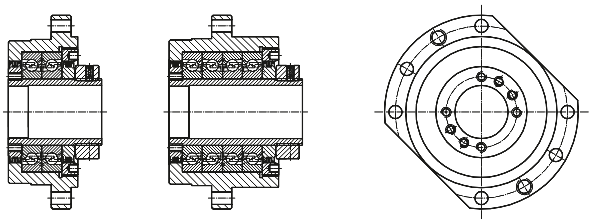
Tolerance Housing	d	M	U_1
		mm	
BSPB 28 D/Q 50 – BNPB 36 D/Q 50	+ 0.003 / - 0.010	0 / - 0.015	0 / - 0.013
BSPB 40 D/Q 65 – BNPB 63 D/Q 65		0 / - 0.018	0 / - 0.015
BSPB 75 D/Q 84 – BNPB 105 D/Q 105			0 / - 0.018

For precision bearing units with integrated lubrication separate data sheets are available for the ball screw nuts (BNPBS series).

IBC also produces special bearing units consisting of an adapter sleeve with optimized mounting flange for bearings for larger ball screw nuts.

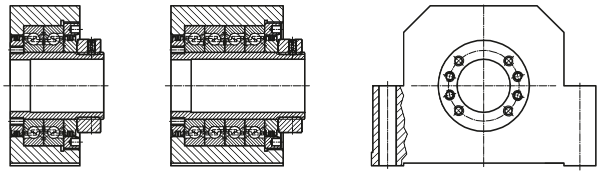
5.5.4 Technical data for IBC precision bearing units with adapter sleeve for ball screw nuts

Flanged form



BNBU...DB... BNBU...QB...

Pillow block form

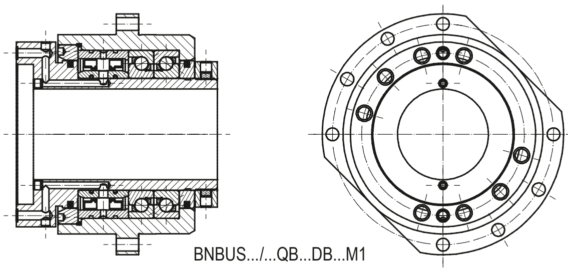


BNPB...D... BNPB...Q...

x57-223

BS	Basic designation		Axial load rating		Preload F_v			Axial stiffness S_{ax}			Speed grease n_F			Frictional torque M_R		
d_o x P	BNBU	BNPB	C_a	C_{oa}	L	M	H	L	M	H	L	M	H	L	M	H
			N			N			N/µm			min^{-1}			Nm	
16 x 5	BNBU 28 DB 98	BNPB 28 D 50	44,300	85,700	1,710	3,850	7,700	900	1,190	1,510	5,000	4,000	2,000	0.20	0.32	0.64
20 x 5	BNBU 36 DB 98	BNPB 36 D 50	44,300	85,700	1,710	3,850	7,700	900	1,190	1,510	5,000	4,000	2,000	0.20	0.32	0.64
25 x 5	BNBU 40 DB 113	BNPB 40 D 65	47,900	105,600	2,110	4,750	9,500	1,090	1,450	1,840	4,000	3,200	1,600	0.30	0.48	0.96
25 x 10	BNBU 40 QB 113	BNPB 40 Q 65	77,600	211,200	4,220	9,500	19,000	2,180	2,900	3,680	2,800	2,200	1,100	0.61	0.97	1.94
32 x 5	BNBU 50 DB 138	BNPB 50 D 65	52,000	134,000	2,690	6,050	12,100	1,150	1,530	1,940	3,200	2,500	1,200	0.52	0.82	1.65
32 x 10	BNBU 50 QB 138	BNPB 50 Q 65	84,200	268,900	5,380	12,100	24,200	2,300	3,060	3,880	2,200	1,700	800	1.03	1.65	3.30
40 x 5	BNBU 63 DB 138	BNPB 63 D 65	52,000	134,000	2,690	6,050	12,100	1,150	1,530	1,940	3,200	2,500	1,200	0.52	0.82	1.65
40 x 10	BNBU 63 QB 138	BNPB 63 Q 65	84,200	268,900	5,380	12,100	24,200	2,300	3,060	3,880	2,200	1,700	800	1.03	1.65	3.30
50 x 5	BNBU 75 DB 178	BNPB 75 D 65	102,100	275,000	5,520	12,420	24,840	1,860	2,460	3,120	2,400	1,900	900	1.11	1.78	3.56
50 x 10	BNBU 75 QB 178	BNPB 75 Q 65	165,400	551,600	11,040	24,840	49,680	3,720	4,920	6,240	1,600	1,300	600	2.23	3.56	7.12
63 x 5	BNBU 90 DB 210	BNPB 90 D 105	111,100	340,400	6,810	15,320	-	2,430	3,210	-	1,900	1,500	-	1.18	1.88	-
63 x 10	BNBU 90 QB 210	BNPB 90 Q 105	180,000	680,800	13,620	30,640	-	4,860	6,420	-	1,300	1,000	-	2.35	3.76	-
63 x 20	BNBU 95 DB 210	BNPB 95 D 105	111,100	340,400	6,810	15,320	-	2,430	3,210	-	1,900	1,500	-	1.18	1.88	-
	BNBU 95 QB 210	BNPB 95 Q 105	180,000	680,800	13,620	30,640	-	4,860	6,420	-	1,300	1,000	-	2.35	3.76	-
80 x 20	BNBU 105 DB 210	BNPB 105 D 105	111,100	340,400	6,810	15,320	-	2,430	3,210	-	1,900	1,500	-	1.18	1.88	-
	BNBU 105 QB 210	BNPB 105 Q 105	180,000	680,800	13,620	30,640	-	4,860	6,420	-	1,300	1,000	-	2.35	3.76	-

Flanged version with integrated lubrication



BNBUS.../...QB...DB...M1

x57-010

BS	Basic designation	Axial load rating		Preload F_v			Axial stiffness S_{ax}			Speed grease n_F			Frictional torque M_R		
d_o x P	BNBUS.../...QB...DB...M1	C_a	C_{oa}	L	M	H	L	M	H	L	M	H	L	M	H
		N			N			N/µm			min^{-1}			Nm	
32 x 20	BNBUS 33/56 QB113.DB...M1	47,900	105,000	2,110	4,750	9,500	1,090	1,450	1,840	4,080	3,280	1,680	0.30	0.49	0.97
40 x 20 50 x 20	BNBUS 51/70 QB138.DB...M1 BNBUS 51/81 QB138.DB...M1	52,000	134,000	2,690	6,050	12,100	1,150	1,530	1,940	3,200	2,560	1,280	0.52	0.82	1.65
63 x 20 80 x 20	BNBUS 78/95 QB178.DB...M1 BNBUS 81/125 QB178.DB...M1	102,100	275,000	6,810	15,320	-	2,430	3,210	-	1,920	1,520	-	1.18	1.88	-

The speed can be increased by 35 % when using ceramic balls. In this case the static load rating C_{oa} is reduced to 70 %

5.6 Application examples for IBC precision bearing units for ball screws

When machine tools were overhauled, slow ball screws were replaced with faster-running ones. By using customer-specific flanged units from IBC, in which the mounting dimensions were maintained, the existing assembly components could be continued to use. A symmetrical bearing arrangement within the housing was developed for horizontal ball screw axes and an asymmetrical arrangement for vertical ball screw axes. The proven integrated locknuts and labyrinth seals are also installed in this bearing unit.

Figs 5.17 and 5.18: IBC precision flange unit for ball screw with location and attachment for gearbox or motor

Fig. 5.19 shows a precision pillow block unit of slender design with central housing locating nut. The precision pillow block unit can be positioned precisely on the machine bed by means of this housing locating groove.

For reasons of space and easy mounting, the fastening holes are made parallel to the axial axis. This means that the lateral space required is significantly reduced.

The proven MD precision locknut is used in the precision pillow block unit to hold the bearing outer rings and the MMRS precision locknut to preload the bearing inner rings.

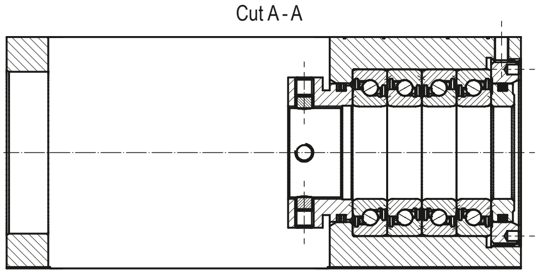
Fig. 5.19: IBC precision pillow block unit

In order to simplify mounting of the assembly it is advisable to incorporate additional functions in addition to the actual bearings in the precision bearing housing. This saves the usual and sometimes time-consuming aligning of various assemblies.

In the case of spindles with direct coaxial drive the motor locating, for example, or if an intermediate gearbox is used, the locating of the same, can be integrated into a lengthened pillow block unit housing.

Fig. 5.20 shows a precision pillow block unit of the BSPB series facing away from the load and with an integrated locating flange for a motor or a gearbox and a coupling. Floating bearing units of the BLPB series, spring-preloaded pillow block units of the BSPB..D..DT+PLS series and precision locating bearing units of the BSPB-M series can also be combined, which have the same centre height M and locating edge U_1. IBC precision bearing units with a symmetrical bearing arrangement are primarily used in horizontal ball screw axes. In addition to a 2:2 arrangement, a 3:3 arrangement is also possible for high axial forces.

Cut A - A



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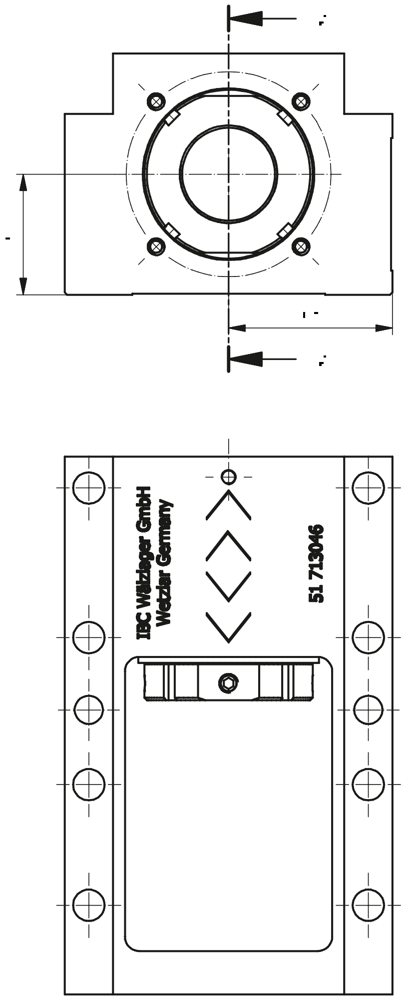

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Fig. 5.20: IBC precision special pillow block unit with motor attachment flange and space for a coupling - painting of the housing optional

Fig. 5.21: Easy to install IBC precision special pillow block unit with asymmetrical bearing arrangement for vertical axes, motor flange integrated underneath - painting of the housing optional

While symmetrical bearing arrangements are nearly always used for horizontal ball screw axes, there is a preference for asymmetrical bearing arrangements with vertical ball screw axes.

The bearing arrangement is designed in accordance with the outer load. Close-tolerance side contact areas at the foot of the pillow block unit provide easy aligning during mounting.

The precision pillow block unit displayed here shows in the foreground the locating option for a motor or an intermediate gearbox. In the rear area of the bearing unit there are precision labyrinth seals for low-friction operation and an integrated precision locknut for preloading. There is space to install a coupling in the area of the recess.

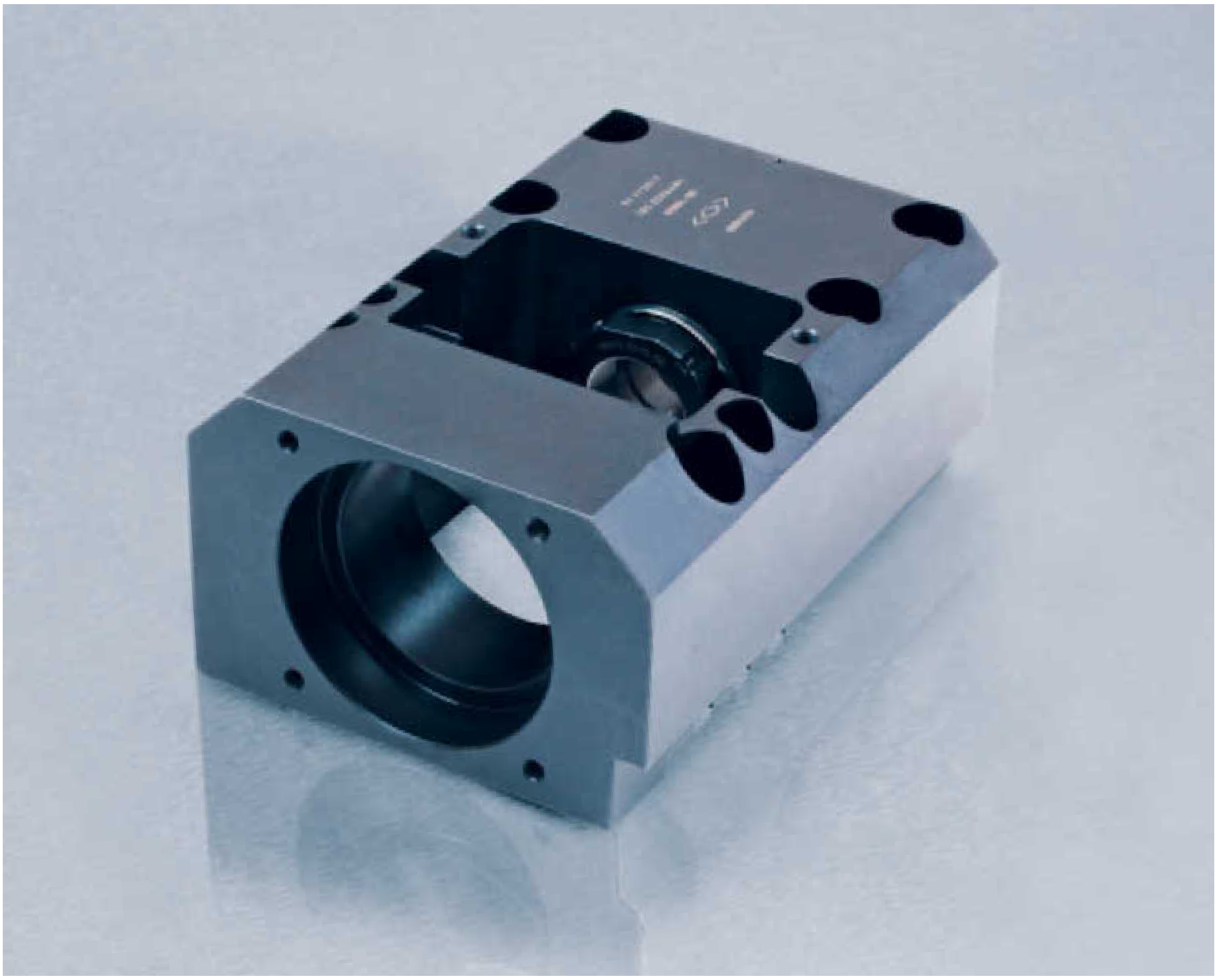


Fig. 5.22: IBC precision special pillow block unit with integrated motor flange

With long machine tool beds, such as, for example, in CNC turning, milling or grinding machines, long ball screw spindles are pretensioned via precision pillow block units. A locating edge at the foot, with tolerances closely matched and machined to the centre axis and a close-tolerance reference or centre fixing height make aligning unnecessary and simplify mounting. In special cases such as this the locating foot can also be stepped.

Fig. 5.23: Easy to mount IBC precision special pillow block units with stepped fixing height and defined locating edge for the pretensioning of a long ball screw

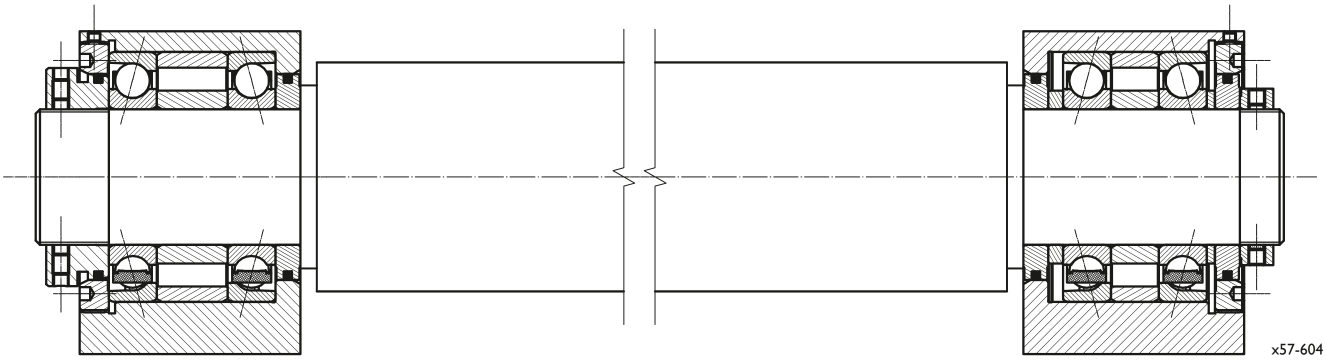


Fig. 5.24: IBC precision special pillow block units of the BSPB-M..Q series, facing away from the load, as precision support bearings - installed as locating and floating bearing

In addition to use in machine tools, special units are also used in other industrial applications where high precision is required. Often existing flange or pillow block units can be modified slightly to meet the customer's requirements. In the case of a supporting bearing that is largely radially loaded in the form of locating and floating bearings, precision ball screw bearings with a contact angle of 15°, 25° or 40° are used with zero clearance.

Other criteria are increasing crucial for the user concerning the implementation of technical requirements.

In the case of pillow block units, such as the BSPB series, mounting is simplified by the close tolerances of the centre height and the machined side locating edge.

The friction is reduced to a minimum by the use of non-contact seals.

The attachment and preloading of precision bearings can be done with IBC precision locknuts of the MMRS series or with precision locknuts of the MMR or MBA series located externally in front.

Applications for this type of bearing are, for example, bearings for rollers, see Fig. 5.24.

6. Materials and coatings

6.1 Materials

Rolling bearing material 100Cr6

Rolling bearing rings and rolling elements are made of vacuum-degassed, fine-grain rolling bearing steel 100Cr6 (1.3505), which has the following technical material properties:

Hardness	60...62 HRC
	650...710 HV
Density	7.83 g/cm^3
Specific heat capacity	0.47 kJ/(kg K)
Thermal conductivity	46 W/(m K)
Electrical resistance coefficient	22 µΩ cm
Coefficient of thermal expansion	12 $\cdot 10^{-6}$/K
Young's modulus	208,000 N/mm^2
Elastic limit	1,370 N/mm^2
Tensile strength	1,570 N/mm^2
Poisson's ratio	0.3

The following table gives an overview of the various designations of 100Cr6 material:

Designation	Material number	USA	Japan
100Cr6	1.3505	SAE52100	SUJ2

Table 6.1: Designations for 100Cr6 material

Heat treatment

Rolling bearing rings made of 100Cr6 are, as standard, dimensionally stable up to a service temperature of 150 °C . In addition, special heat treatments for higher temperatures are available on request and are possible as long as all the components have been designed for this higher operating temperature.

Rolling elements made of ceramics – silicon nitride Si_3N_4

Rolling elements made of ceramics have the following advantages:

- extreme hardness
- high mechanical strength
- good resistance to corrosion and abrasion
- low thermal and electrical conductivity
- low specific weight

As a result of these properties, silicon nitride is highly suited for use in rolling bearings. In addition to this, silicon nitride has reduced adhesion compared to steel and hence makes fewer demands on the lubricant.

Fig. 6.1: Rolling elements made of Si_3N_4 and 100Cr6

Even in the case of initial and further advanced damage to the raceways, the ceramic rolling elements still retain their rolling stability in the vast majority of cases. Silicon nitride has the following material properties:

Hardness	1,600 HV
Density	3.24 g/cm^3
Thermal conductivity	25 W/(m K)
Electrical resistance coefficient	10^{13} Ω cm
Coefficient of thermal expansion	3.4 $\cdot 10^{-6}$/K
Young's modulus	300,000 N/mm^2
Elastic limit	1,050 N/mm^2
Poisson's ratio	0.27

Cage material - polyamide (P)

Glassfibre-reinforced polyamide is used as a material for the cages. Polyamide combines low weight with good damping and sliding properties. Thus bearings that use this material have a shortened grease distribution run. Bearings with polyamide cages can be used in the temperature range from - 40 °C to +100 °C. Higher temperatures of up to +120 °C can be implemented for short periods.

Materials for seals

Sealed high-precision angular contact ball bearings offer a high degree of reliability and safety. The seal largely protects the rolling bearing against contamination and thus lengthens the lifetime, both of the lubricant as well as of the bearing as a whole. Acrylonitrile butadiene rubber (NBR) has more than proved its worth as a material for seals. This material exhibits good resistance to most media and can be used up to a temperature of 100 °C. Higher temperatures of up to 120 °C can be implemented for short periods.

6.2 IBC rolling bearings with ATCoat coating

Fig. 6.2: ATCoat-coated precision 60° ball screw support bearings

ATCoat-coated bearings

The material surface of rolling bearings makes an ever increasing contribution to the performance of machines, units and systems. External influences very frequently change the surface properties of the materials or even attack them. Treating the material surface of rolling bearings has a wide variety of advantages.

The ATC thin chromium coating protects surfaces against external ambient influences and thus permits a lengthening of the working life of rolling bearings and also the lifetime of machines and units. The ATCoat process permits a combination of a tough base material with a firmly adhering, very thin, precise and crack-free coating of chromium. Thus the ATCoat coating offers very good protection against wear and corrosion for the same dimensioning of the rolling bearings.

ATCoat-coated rolling bearings represent an alternative to rolling bearings made of corrosion-resistant steel - it provides a comparable level of corrosion protection behaviour, especially on the functional surfaces. The coat thickness of 2-4 µm with a cone-shaped surface structure displays superlative characteristics even in extreme conditions. In particular, when used in connection with ceramic rolling elements, considerable increase in the speed of rotation at low operating temperatures are made possible due to ATCoat coating.

In many cases the trouble-free use of machines and units is prolonged by avoiding fretting corrosion on floating bearings that had been caused by micro-shifting of the rolling bearing outer rings due to thermal expansion or vibration. The special topography of the surface in addition significantly improves the emergency running properties of the rolling bearings. For example, in the event of a failure of the lubrication system, the units can still be run for a certain time under partial load or shut down in a controlled way. Consequential damage is thus reduced or prevented. IBC high-precision rolling bearings with ATCoat coating are therefore frequently used where there are unfavourable lubrication conditions.

Such unfavourable conditions exist for example, if:

- no lubrication at all can be provided in a certain environment;
- it is only possible to lubricate with low viscosity media that do not create a sparating lubricating film;
- there are very low speeds that do not allow an elasto-hydro-dynamic lubricating film to be formed;
- there are oscillating movements such as weaving or swivelling in which there are no full rotations produced, and a separating lubricating film cannot be maintained at the reversal points;
- sliding occurs in the raceways of unloaded rolling bearings;
- there is smearing by the sliding rolling bearings during rapid or delays due to inertia from the moment of inertia in connection with inadequate preloading, also in the case of small oscillating movements and vibrations.

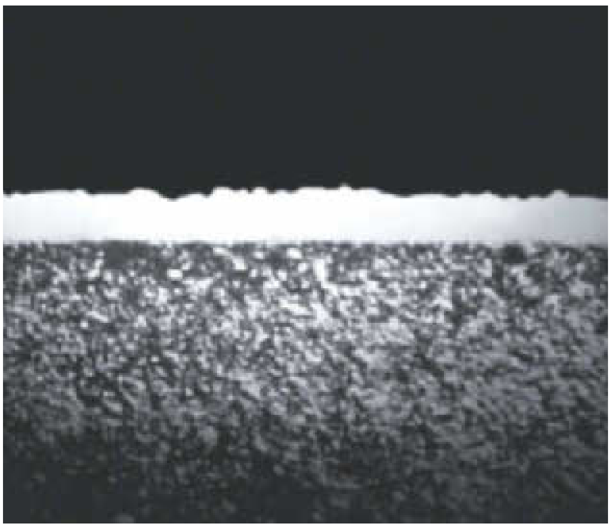


Fig. 6.3: Cross-section of ATCoat coating

In mould making and applications with limited rotary movements contact corrosion can develop due to a lack of a separating lubricating film between the rolling elements and the raceways.

For these application cases IBC offers precision 60° ball screw support bearings with ATCoat-coated raceways. In addition, these configurations can also be supplied with ceramic rolling elements.

Fig. 6.4: ATCoat-coated double-row IBC precision 60° ball screw support bearing AC-BSDF 40MS115.2RSZ.P4.BM.A11

Fig. 6.5: IBC precision pillow block unit AC-BSPB 60 Q 85.M with ATCoat coated rolling bearings

The recommended fits on pages 35, 36 and 54 relate to uncoated rolling bearings. Revised tolerances for shaft diameter and housing bores apply to ATCoat-coated rolling bearings. If the lifetime is to be extended with the same component parts, the outer diameter and the bore of the bearing can be provided without coating (suffix A11L; A11LF) so that the relevant tolerances are preserved. IBC application technicians would be able to provide this advice.

Further information can be found in the catalogue **IBC Rolling Bearings with ATCoat Coating TI-I-5011.2 / E**.

7. IBC precision components

IBC precision locknuts and **labyrinth seals** complete the comprehensive modular system of IBC rolling bearings. Complete solutions to match an application can be implemented quickly with precision bearing units. They provide for the user highly precise and low-friction bearings with high load-bearing capacity for ball screw spindles. The easy mounting and low-maintenance and hence economic use result in an optimization of the entire machine tool.

The performance of a tool spindle is significantly influenced by fixing of the precision rolling bearings and other machine parts on the shaft in a secure and plane-parallel manner, due to their high precision. IBC precision locknuts are also used in other industrial sectors to ensure the precise fixing of machine elements and hence for positioning that is permanently accurate and safe in operation. Their dimensions are matched to the mounting dimensions of precision rolling bearings and have been designed for a wide variety of precision rolling bearing applications.

The wide variety of fastening solutions implemented has resulted in a variable modular system that allows the designer a great deal of flexibility in designing alternative versions.

Easy and precise assembly and fixed mounting are guaranteed by the various locking systems that are built into the precision locknuts. The locking grooves that are used otherwise to hold locking washers are dispensed with and hence the notch effect is reduced. In addition, IBC precision locknuts can be reused, since the precision of the locknuts is retained after they have been unlightened and tightened up again. This reduces costs in the event of servicing.

In the following there is information on precision components that can be used to advantage with bearings for ball screws. More detailed descriptions of applications and calculations is given in the IBC catalogue **High Precision Locknuts TI-I-5020.1 / E**.

Series

There are a number of different series with axial or radial locking devices available for all kinds of applications and demands. If it is a matter of compact applications or weight reduction then we recommend our **IBC precision locknuts** of the **MMR**, **MMRB** and **MMRS**, series, with radially-acting locking devices (see page 78 ff.). These locknuts are made up of locking devices that can be screwed in, with incorporated brass inserts to the nut thread. The locking devices are distributed around the circumference and are tensioned to lock radially on the shaft thread (see Fig. 7.4, page 76).

In the case of applications with locations that are set back and cannot be accessed radially, such as in housing bores, we recommend **IBC precision locknuts** of the **MBA** and **MBC** series, in which the locking is done by using axially accessible pressure or clamping screws (see Fig. 7.3 on page 75 and the tables on page 80).

Fig. 7.1: IBC precision locknut MBA with axial locking devices

In these locknuts there are slotted segments with an incorporated nut thread that is deformed elastically in an axial direction by grub screws and clamps against the thread flanks of the shaft (see Fig. 7.3.). Due to its construction, this type requires a greater width. The locking system of the precision locknuts can increase the axial preloading of the precision locknuts slightly in the MBA type and reduce it slightly in the MBC type. The MBA type is produced with a thread diameter of 20 mm and above. The MBC version with four internal hexagon socket screws is produced with a thread diameter of 45 mm up to a thread diameter of 300 mm.

The MMRB version with a radial locking system uses the same cross-section of the MBA and MBC precision locknuts and permits greater loads and higher tightening torques. This is especially advantageous for the preloading of rolling bearings that are heavily loaded axially in ball screws.

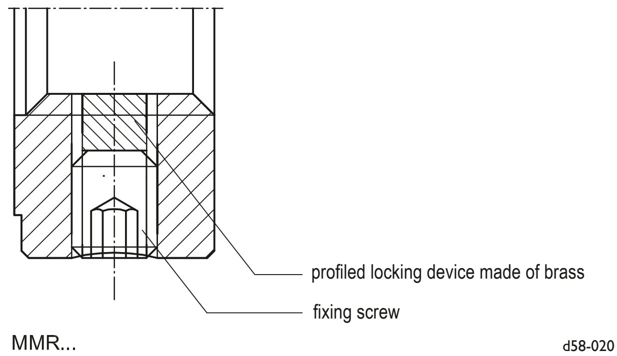
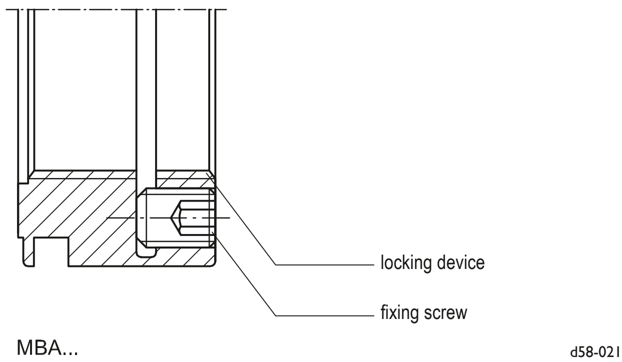


Fig. 7.2: Detail drawing locking system MMR - the same principle also in MMRB and MMRS

Series of IBC precision locknuts and labyrinth seals	
MMR	narrow precision locknuts with radial locking
MMRB	wide precision locknut with radial locking
MMRBS	as for MMRB, but with laminar seal
MBA	Precision locknuts with axial locking via slotted segments and pressure screws
MBAS	as for MBA, but with laminar seal
MBC	Precision locknuts with axial locking via slotted segments and clamping screws
MMA	Precision locknuts with axial locking via 2 cones, only for small locknuts
MMRS	Special precision groove locknuts with radial locking, matched to 60° ball screw support bearings (BS ...) and seal ring nut MD
MD	Precision seal ring locknut with fine outer thread, for the S and MMRS series
MDA	Precision seal ring locknut with fine outer thread, locking via slotted segments, for the S and MMRS series
S	Precision labyrinth seal with steel laminar rings, matched to seal ring nut MD

Table 7.1: Designations for IBC precision locknuts and labyrinth seals



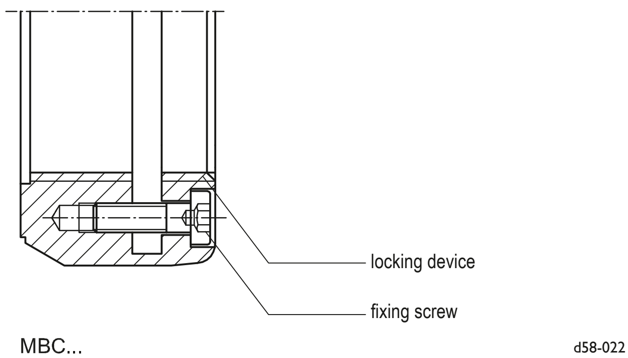


Fig. 7.3: Detail drawing locking systems MBA and MBC

Tolerances

As both the internal thread with its locking devices and the face are ground by precision finishing in a single clamping operation, IBC high precision locknuts attain a high axial face runout according to IT3 or better, ISO standard tolerance classes according to German standard DIN ISO 281 T1. The locking devices, which are also profiled, bear on the flanks of the thread. The thread is manufactured with a tolerance of 4H according to German standard DIN 13 T21-24; from M210x4 the tolerance is 6H.

Mounting dimensions

The recommended tolerance of the shaft counter thread is "medium" according to 6g and 6h; it is "fine" according to 4h for higher accuracy requirements (machine tools).

Strength of the locknut threads

The axial strengths specified below are applicable to shaft threads with a tensile strength of at least 700 N/mm^2. In the case of dynamic load, 75 % of axial strength is permissible.

- Threads up to M50: 1.000 N/mm^2
- Threads exceeding M50: 650 N/mm^2

Modular system

IBC precision locknuts should be screwed on with all locking devices in an unchanged position. Using a hook spanner or a socket wrench, the precision locknuts are then tightened up to twice the tightening torque T as compensation for any settling. The tightening torque depends on the required preload and the required slide fit (in the case of precision rolling bearings for ball screws) or press fit in other applications. Next, the precision locknuts are loosened again and tightened up to the minimum required preload torque M_D. Detailed calculations for the tightening torques are given in our catalogue **IBC High Precision Locknuts, TI-I-5020.1 / E**.

Securing against loosening

IBC precision locknuts have various locking systems, depending on the configuration. The basis for all versions is that the thread of the shaft and the locknut are not damaged by the mounting and locking and hence it can be undone and tightened up again without damage.

Precision locknuts with labyrinth seals

The MMRB and MBA series are available in addition with an integrated labyrinth seal as MMRBS and MBAS (see page 78 ff.). Spring-steel laminar rings in combination with a stepped housing make up a compact labyrinth seal. The space within the labyrinth area is to be filled with grease before and after mounting. Precision locknuts with a labyrinth seal represent an alternative to contact seals.

Wide precision locknuts with labyrinth seals of the MMRBS series (page 78) have been matched to the cross-section of the single-row 60º ball screw support bearings of the BS series and the seal ring locknut MD. In addition to the standard sizes shown, special sizes, stainless steel versions and locknuts with ATCoat coating are available.

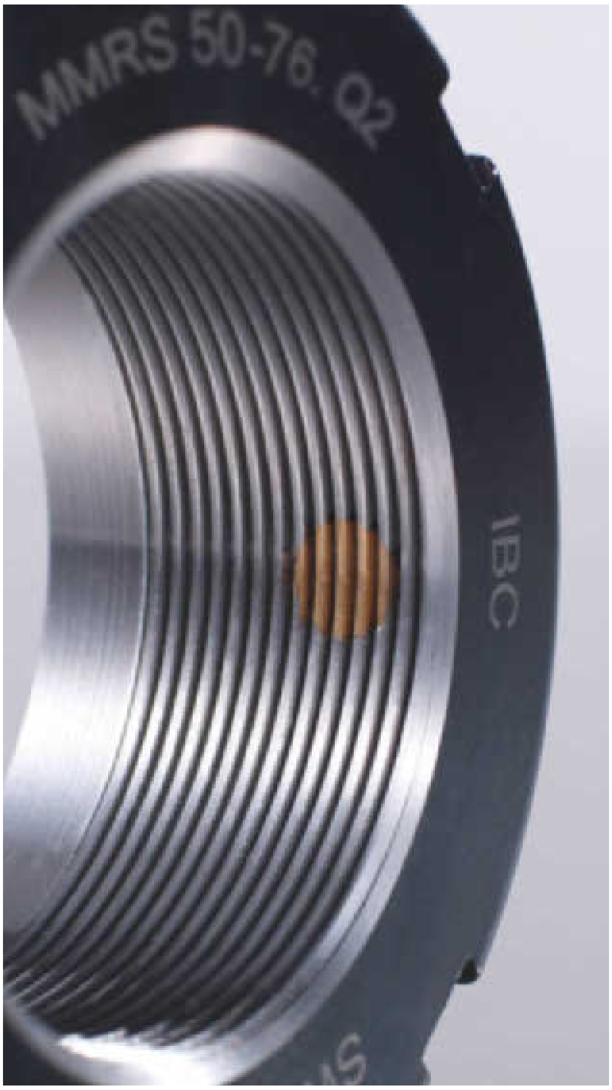


Fig. 7.4: IBC precision locknut MMRS with radial locking devices

Locking process

Fundamentally speaking, the following procedures should be followed with radial and axial locking systems:

First of all, the locking screws are tightened up one after another until a resistance can be felt. The locking screws are tightened up alternating between the screws on both sides. First of all with 30 %, then with 70 % and finally with the maximum tightening torque M_A.

The maximum permissible tightening torques M_A for the grub screws and internal hexagon socket screws can be found in table 7.2 below.

As a result of the defined tightening torques, there are high loosening torques to prevent unintended loosening during alternating clockwise and anticlockwise running and during especially rapid acceleration of the spindle.

Dismantling

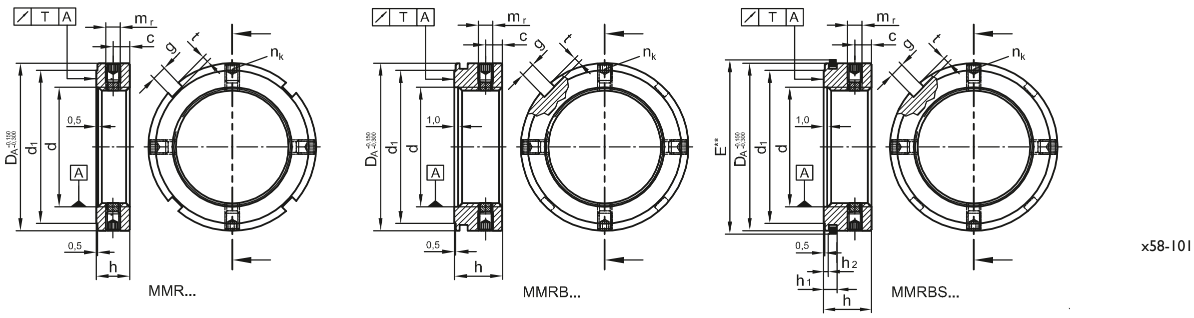
When dismantling, the locking devices must first of all be loosened slightly and evenly. Since the profiled locking devices are made of brass and the slotted segments are not deformed significantly when they were tightened up, the precision locknut can be reused several times without a loss of precision after being undone.

Locking thread	**Wrench size**		**Maximum tightening torque M_A**		
			Grub screws with hexagonal recess		**Countersunk screw with hexagonal recess**
	S_{MBA} S_{MMR} S_{MMRB} S_{MMRS}	S_{MBC}	MMR / MMRB / MMRS	MBA	MBC
	mm		Nm		Nm
M4	2	3	2	2	4.5
M5	2.5	4	4	4	8.5
M6	3	5	7	7	15
M8	4	6	18	9	36
M10	5	-	34	15	-
M12	6	-	60	36	-
M14	6	-	85	45	-

Table 7.2: Maximum permissible tightening torques M_A [Nm] of the grub screws and hexagonal recess

Fig. 7.5: IBC precision pillow block unit with precision locknuts, precision ball screw support bearings and precision labyrinth seal. Compare section 5.2.2, page 45 ff.

7.1 IBC precision locknuts MMR, MMRB, MMRBS and MBA, MBAS, MBC, MMA



Thread	Basic designation	Dimensions										Maximum tightening torque lock screws	Permissable axial load
	MMR, MMRB / MMRBS											MMR, MMRB / MMRBS	MMR, MMRB / MMRBS
d		D_A	h	g	t	d_1	c	m_r	h_1	h_2	E**	M_A	F_a
Tolerance* 4H	with radial locking	mm										Nm	kN
M 6 x 0.5	MMR 6	16	8	3	2	12	4	M 4		-	-	2	16
M 8 x 0.75	MMR 8												17
M 10 x 0.75	MMR 10	18				14							22
M 10 x 1	MMR 10 x 1												22
M 12 x 1	MMR 12	22				18							26
M 15 x 1	MMR 15	25				21							33
M 16 x 1.5	MMR 16 x 1.5	28	10	4		23	5						37
M 17 x 1	MMR 17							M 5				4	49
M 20 x 1	MMR 20	32				27							55
	MMRB 20		16						4.7	1.5	32		110
M 20 x 1.5	MMR 20 x 1.5		10										70
	MMRB 20 x 1.5		16								32		110
M 25 x 1.0	MMR 25 x 1.0	38	12	5		33	6	M 6				7	87
M 25 x 1.5	MMR 25												87
	MMRB 25		18						5.1	1.9	38		130
M 30 x 1.5	MMR 30	45	12			40				1.6	45		110
	MMRB 30		18										150
M 33 x 1.5	MMR 33		12										130
M 35 x 1.5	MMR 35	52				47							120
	MMRB 35		18							1,5	52		170
M 40 x 1.5	MMR 40	58	14	6	2.5	52	7						150
	MMRB 40		20								58		210
M 42 x 1.5	MMR 42		14										150
M 45 x 1.5	MMR 45	65				59							170
	MMRB 45		20						5.5	1.9	65		240
M 50 x 1.5	MMR 50	70	14			64							180
	MMRB 50		20						6	2.3	70		260
M 55 x 2	MMR 55	75	16	7	3	68	8	M 8				18	250
	MMRB 55		22							2	75		340
M 60 x 1.5	MMR 60 x 1.5	80	16			73							270
M 60 x 2	MMR 60												270
	MMRB 60		22								80		360
M 65 x 1.5	MMR 65 x 1.5	85	16			78							290
M 65 x 2	MMR 65												290
	MMRB 65		22								85		400
M 70 x 2	MMR 70	92	18	8	3.5	85	9						350
	MMRB 70		24								92		470
M 75 x 2	MMR 75	98	18			90							370
	MMRB 75		24								98		500
M 80 x 2	MMR 80	105	18			95							390
	MMRB 80		24						6.3	1.5	105		520
M 85 x 2	MMR 85	110	18			102		M 10				34	400
	MMRB 85		24								110		540

Thread	Basic designation	Dimensions										Maximum tightening torque lock screws	Permissable axial load
	MMR, MMRB / MMRBS											MMR, MMRB / MMRBS	MMR, MMRB / MMRBS
d		D_A	h	g	t	d_1	c	m_r	h_1	h_2	E**	M_A	F_a
Tolerance* 4H	with radial locking	mm										Nm	kN
M 90 x 2	MMR 90	120	20	10	4	108	9	M 10				34	470
	MMRB 90		26						7	2.2	120		610
M 95 x 2	MMR 95	125	20			113							490
	MMRB 95		26								125		640
M 100 x 2	MMR 100	130	20			120							510
	MMRB 100		26						7	2.2	130		660
M 105 x 2	MMR 105	140	22	12	5	126							560
	MMRB 105		28						7.5	2.7	140		700
M 110 x 2	MMR 110	145	22			133							600
	MMRB 110		28								145		770
M 115 x 2	MMR 115	150	22			137							660
	MMRB 115		28								150		820
M 120 x 2	MMR 120	155	24			138							710
	MMRB 120		30								155		890
M 125 x 2	MMR 125	160	24			148							740
	MMRB 125		30								160		920
M 130 x 2	MMR 130	165	24			149							760
	MMRB 130		30						7.5	2.6	165		950
M 135 x 2	MMR 135	170	24			155							820
	MMRB 135		30								170		1,010
M 140 x 2	MMR 140	180	26	14	6	160	10	M 12				60	880
	MMRB 140		32								180		1,080
M 145 x 2	MMR 145	190	26			171							920
M 150 x 2	MMR 150	195											930
	MMRB 150		32								195		1,040
M 160 x 3	MMR 160	205	28	16	7	182							1,050
	MMRB 160		34						8.5	2.7	205		1,360
M 165 x 3	MMR 165	210	28			193							1,075
M 170 x 3	MMR 170	220				198	14						1,125
	MMRB 170		34								220		1,430
M 180 x 3	MMR 180	230	30	18	8	203	15						1,260
	MMRB 180		36								230		1,600
M 190 x 3	MMR 190	240	30			214							1,300
	MMRB 190		36								240		1,670
M 200 x 3	MMR 200	250	32			226	16						1,440
	MMRB 200		38								250		1,850
M 210 x 4	MMRB 210	270	40	20	10	238	14	M 14	10		270	85	2,000
M 220 x 4	MMRB 220	280				250					280		2,250
M 240 x 4	MMRB 240	300	44			270					300		2,300
M 260 x 4	MMRB 260	310				290					310		2,500
M 280 x 4	MMR 280	330	26	24		310	12						1,235
M 280 x 4	MMRB 280		50				15			2.6	330		2,850
M 300 x 5	MMRB 300	360				336					360		3,100

Runout T in accordance with IT3, DIN ISO 286 T1

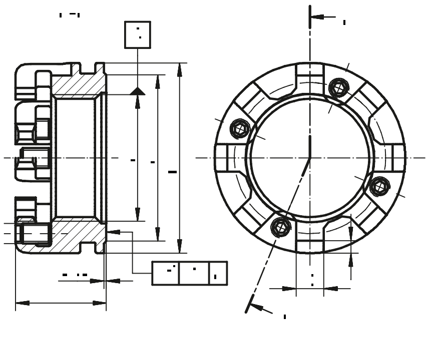
* From Ø 200 : 6H

n_K: Number of clamping elements = 4

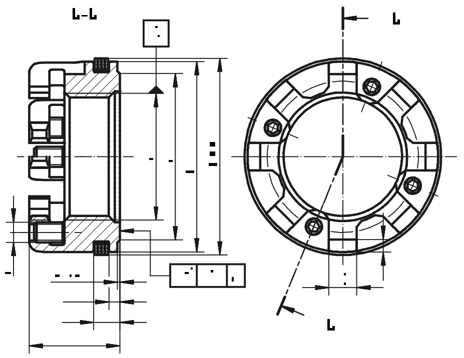
MMRBS = MMRB + laminar spring steel rings (labyrinth seal)

E** = Housing connection diameter = $D_A\,^{+0,1}_{\ 0}$ and a 25° lead-in chamfer for the seal, whose introductory diameter is 4 % greater than D_A

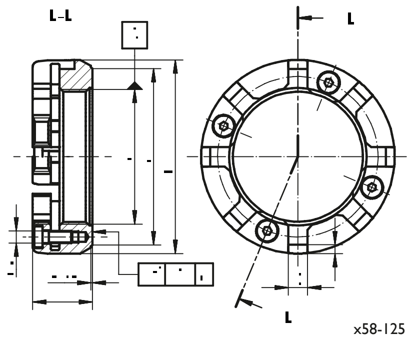
A special version of the MMR locknut is one with a rear side ground plane-parallel to the tightening side (MMR-PR...). This permits direct measurement of the axial runout of a rolling bearing at the locknut. In addition, this gives the option to connect additional elements to this contact surface.



MBA...



MBAS...



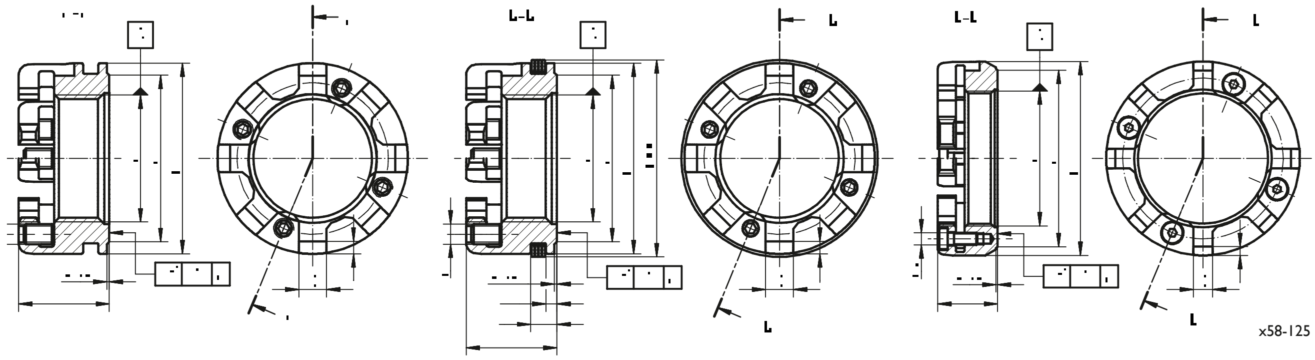
MBC...

Thread d Toleranz* 4H	Basic designation MBA / MBAS, MBC, MMA with radial locking	Dimensions D_A	h	g	t	d_1	m	m_c	h_1	h_2	E**	Maximum tightening torque lock screws MBA M_A	MBC	Permissable axial load MMA MBA MBC F_a
		mm										Nm		kN
M 17 x 1	MMA 17**	28	16	4	2	23	M 4					2		70
M 20 x 1	MBA 20***	32				27			4.7	1.5	32			110
M 20 x 1.5	MBA 20 x 1.5***													110
M 25 x 1.5	MBA 25	38	18	5		33			5.2	2	38			130
M 30 x 1.5	MBA 30	45				40	M 6		5	1.5	45	7		150
M 35 x 1.5	MBA 35	52				47					52			120
M 40 x 1.5	MBA 40	58	20	6	2.5	52					58			150
M 45 x 1.5	MBA / MBC 45	65				59		M 4	5.5	1.5	65		4.5	170
M 48 x 1.5	MBA 48 x 1.5	70				64								180
M 50 x 1.5	MBA / MBC 50								6	2	70			180
M 55 x 2	MBA / MBC 55	75	22	7	3	68	M 8				75	9		250
M 60 x 2	MBA / MBC 60	80				73					80			270
M 64 x 2	MBA 64	85				78					85			290
M 65 x 2	MBA / MBC 65													290
M 70 x 2	MBA / MBC 70	92	24	8	3.5	85		M 5			92		8.5	350
M 75 x 2	MBA / MBC 75	98				90					98			370
M 80 x 2	MBA / MBC 80	105				95			6.7	2	105			390
M 85 x 2	MBA / MBC 85	110				102	M10				110	15		400

Further sizes on request

* From Ø 200 : 6H
** Lock: 2 cones less than 90°
*** Lock: 3 Locking devices and 6 hook grooves

(See page 86 for application example)



MBA... MBAS... MBC...

Thread	Basic designation	Dimensions										Maximum tightening torque lock screws		Permissable axial load
	MBA / MBAS MBC											MBA	MBC	MBA, MBC
d		D_A	h	g	t	d_1	m	m_c	h_1	h_2	E**	M_A		F_a
Tolerance* 4H	axial locking	mm										Nm		kN
M 90 x 2	MBA / MBC 90	120	26	10	4	108	M 10	M 5	6.7	2	120	15	8.5	470
M 95 x 2	MBA / MBC 95	125				113					125			490
M 100 x 2	MBA / MBC 100	130				120		M 6			130		15	510
M 105 x 2	MBA / MBC 105	140	28	12	5	126					140			560
M 110 x 2	MBA / MBC 110	145				133					145			600
M 115 x 2	MBA / MBC 115	150				137			6.9		150			660
M 120 x 2	MBA / MBC 120	155	30			138					155			710
M 125 x 2	MBA / MBC 125	160				143					160			740
M 130 x 2	MBA / MBC 130	165				149			7.4	2.5	165			760
M 135 x 2	MBA 135	170				154								780
M 140 x 2	MBA / MBC 140	180	32	14	6	160	M 12	M 8			180	36	36	880
M 145 x 2	MBA 145	185				160					185			900
M 150 x 2	MBA / MBC 150	195				165					195			930
M 160 x 3	MBA / MBC 160	205	34	16	7	182			8.3		205			1,020
M 170 x 3	MBA / MBC 170	220				198 / 193					220			1,075
M 180 x 3	MBA / MBC 180	230	36	18	8	203					230			1,200
M 190 x 3	MBA / MBC 190	240				214					240			1,250
M 200 x 3	MBA / MBC 200	250	38			226					250			1,390
M 210 x 4	MBA / MBC 210	270	40	20	10	238	M 14		10.2	3	270	45		1,500
M 220 x 4	MBA / MBC 220	280				250					280			1,685
M 240 x 4	MBA / MBC 240	300	44			270					300			1,720
M 260 x 4	MBA / MBC 260	310				290					310			1,875
M 280 x 4	MBA / MBC 280	330	50	24		310			10.3		330			2,130
M 300 x 4	MBA / MBC 300	360				336								2,325

Further sizes on request

Runout T in accordance with IT3, DIN ISO 286 T1

* From Ø 200 : 6H

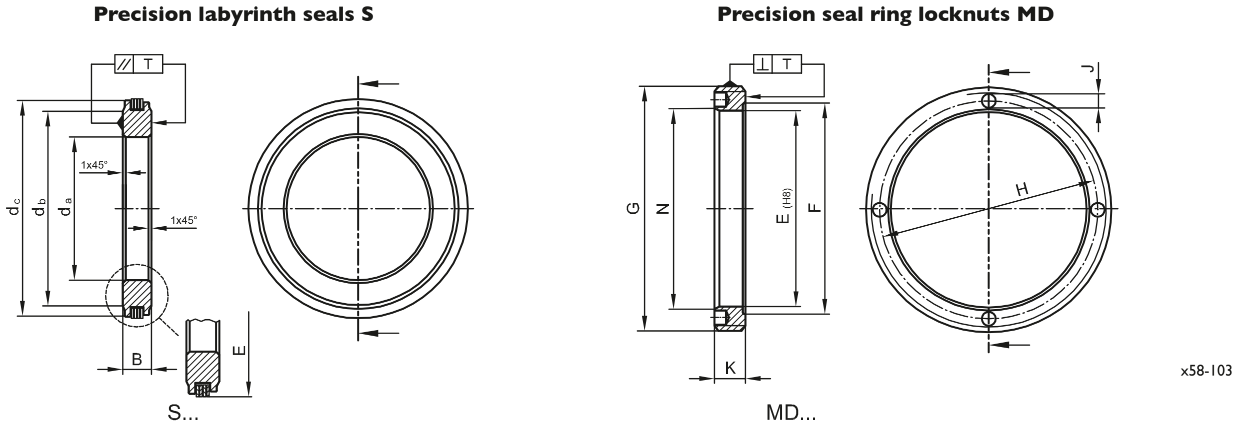
n_K: Number of clamping elements = 4

MMRBS = MMRB + laminar spring steel rings (labyrinth seal)

E** = Housing connection diameter = $D_A\ {}^{+0,1}_{\ 0}$ and a 25° lead-in chamfer for the seal, whose introductory diameter is 4 % greater than D_A

A special version of the MMR locknut is one with a rear side ground plane-parallel to the tightening side (MMR-PR...). This permits direct measurement of the axial runout of a rolling bearing at the locknut. In addition, this gives the option to connect additional elements to this contact surface.

7.2 IBC precision labyrinth seals S and IBC precision seal ring locknuts MD



Basic designation	Dimensions				Basic designation	Dimensions							Permissable axial load
S	d_a	d_b	d_c	B	MD	E	F	G	H	J	K	N	F_a
						mm							kN
S 12-26	12	21	25.5	7	MD 40-26	26	28	M 40 x 1.5	32	4.3	9	27	45
S 15-26	15				MD 45-26			M 45 x 1.5					55
S 17-36	17	26	35.5		MD 50-36	36	41	M 50 x 1.5	42.5		10	37.5	65
S 20-36	20												
S 25-40	25	32	39.5		MD 55-40	40	45	M 55 x 1.5	47			42	77
S 25-50		41	49.5	10	MD 70-50	50	55	M 70 x 1.5	59.5		12	53.73	100
S 30-50	30												
S 30-60		46	59.5		MD 80-60	60	65	M 80 x 1.5	72			63	130
S 35-60	35												
S 35-76		66	75.5	12	MD 110-76	76	92	M 110 x 2	90	6.3	14	79.5	190
S 40-60	40	50	59.5	10	MD 80-60	60	65	M 80 x 1.5	72	4.3	12	63	130
S 40-76-10		66	75.5		MD 95-76	76	82	M 95 x 2	84.5			79,5	150
S 40-76				12	MD 110-76		92	M 110 x 2	90	6.3	14		190
S 45-60	45	55	59.5	10	MD 80-60	60	65	M 80 x 1.5	72	4.3	12	63	130
S 40-66			65.5		MD 85-66	66	72	M 85 x 1.5	76			69	
S 45-66		60											
S 45-76		66	75.5	12	MD 110-76	76	92	M 110 x 2	90	6.3	14	79.5	190
S 50-76-10	50	68		10	MD 95-76		82	M 95 x 2	84.5	4.3	12		150
S 50-76				12	MD 110-76		92	M 110 x 2	90	6.3	14		190
S 55-76-10	55			10	MD 95-76		82	M 95 x 2	84.5	4.3	12		150
S 55-76				12									
S 55-99		86	98.5		MD 130-99	99	110	M 130 x 2	112	6.3	14	103	220
S 60-99	60												
S 70-99	70												
S 75-99-10				12									
S 75-99	75			10	MD 120-99		101	M 120 x 2					210
S 80-132	80	114	131.5	14	MD 175-132	132	147	M 175 x 3	153	8.3	24	139	495
S 80-132-16				16									
S 80-132-24				24									
S 85-132	85			14									
S 90-132	90												
S 100-132	100				MD 160-132		134	M 160 x 3	148	6.3	18	137.3	340
S 100-162		142	161.3	24	MD 220-162	162	172	M 220 x 3	190	10.3	24	170	620
S 110-132	110	120	131.5	14	MD 160-132	132	134	M 160 x 3	148	6.3	18	137.3	340
S 127-162	127	144	161.3	14.5	MD 190-162	162	167	M 190 x 3	176			166	440

Further sizes on request

For the non-contact sealing of individual bearings and bearing sets IBC precision labyrinth seals S in combination with IBC precision seal ring locknuts MD are used. The inner diameter of the MD seal ring nut is matched to the IBC precision labyrinth seal S.

Both elements can be combined accordingly. The table above shows the possible combinations between the precision labyrinth seal S and the MD locknuts.

The non-contact sealing elements of the S series consist of a plane-parallel ground steel ring with a radial circumferential groove, in which spring steel laminar rings are fitted. The laminar rings are surrounded by a grease pack (GH62).

During mounting, the sealing elements are pressed into the bore of a matching precision seal ring locknut of the MD series, or into a housing bore, via an lead-in chamfer, thereby fixing them in their position. The spacer ring (supporting ring) of the labyrinth seal that is positioned on the shaft will now turn without making contact with the spring rings. A grease pack in the groove will prevent the spring rings from axially running up against the axial shoulders.

In addition to the sealing elements listed on page 82, IBC offers the following non-contact seals that cannot be combined with seal ring locknuts. These seals are primarily used for floating bearings or other design purposes.

Series	**Dimensions**			
S	d_a	d_b	d_c	B
		mm		
S 30-72	30	46	71.5	12
S 35-72	35	46	71.5	12
S 35-99	35	66	98.6	12
S 40-72	40	50	71.5	12
S 40-99	40	66	98.6	12
S 40-100	40	66.5	98.6	12
S 45-75	45	55	74.5	12
S 45-99	45	66	98.6	12
S 50-99	50	68	98.60	12
S 65-105	65	100	104.5	12
S 65-120	65	105	119.50	12
S 80-115	80	102	114.50	12
S 82-99-10	82	90	98.6	10
S 85-130	85	105	129.5	12
S 90-130	90	105	129.5	12
S 140-180-12	140	160	179.5	12
S 180-220-14	180	200	219.5	14

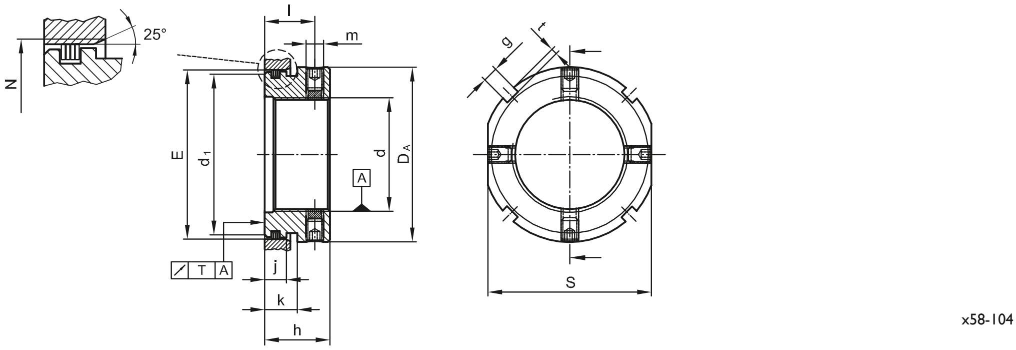
Table 7.3: Labyrinth seal S for direct sealing against the housing (floating bearing). Further sizes on request

In the case of floating bearings with a long displacement path the side surfaces and the laminar rings are coated additionally with an anti-friction coating (GL). The groove width of the laminar carrier is matched to the total displacement path as required. The cylindrical slide surface in the housing should have a low level of roughness ($R_a \leq 0{,}4$ µm; from Ø 80 mm: $R_a \leq 0{,}8$ µm) and greased or coated to prevent corrosion.

The MD seal rings with external thread can be used separately to lock the bearing outer rings or other machine parts. Since seal ring nuts have no locking devices, they require a form of locking, e.g. with thread locker or other machine elements. As with all IBC precision locknuts, the thread is in accordance with IT3, DIN ISO 286 T1.

Fig. 7.6: ATCoat-coated seal ring locknut AC-MD ...

7.3 IBC precision labyrinth groove locknuts MMRS



MMRS...

Thread	Basic designation	Dimensions												Maximum tightening torque lock screws	Permissable axial load
d	MMRS	E	D_A	h	g	t	d_1	l	m	j	k	N	S	M_A	F_a
Tolerance 4H		mm												Nm	kN
M 17 x 1	MMRS 17-36	36	38	20	5	2	32	15.5	M 5	9	11	37.5	36	4	100
M 20 x 1	MMRS 20-36									9	11				110
M 22 x 1	MMRS 22-36						33.8			9	11				110
M 25 x 1.5	MMRS 25-50	50	58	25	6	2.5	46	19	M 6	10	13	52	55	7	150
M 27 x 1.5	MMRS 27-50														
M 30 x 1.5	MMRS 30-50														180
M 30 x 1.5	MMRS 30-60	60	70	28			56	21	M 8			63	65	18	
M 35 x 1.5	MMRS 35-60														190
M 40 x 1.5	MMRS 40-60														210
M 45 x 1.5	MMRS 45-60														260
M 35 x 1.5	MMRS 35-76	76	80	30	7	3	72	23			15	79.5	75		290
M 40 x 1.5	MMRS 40-76														340
M 45 x 1.5	MMRS 45-76														400
M 50 x 1.5	MMRS 50-76														420
M 55 x 2	MMRS 55-76														450
M 60 x 2	MMRS 60-76														480
M 55 x 2	MMRS 55-99	99	105		8	3.5	95					103	95		450
M 60 x 2	MMRS 60-99														480
M 65 x 2	MMRS 65-99														
M 75 x 2	MMRS 75-99														510
M 80 x 2	MMRS 80-132	132	140	46	12	5	128	35	M 10	21	25	137.5	135	34	810
M 100 x 2	MMRS 100-132			35			128	27		12	19				710
M 100 x 2	MMRS 100-162	162	170	46	16	7	138	35		21	25	168.5	160		1,000
M 125 x 2	MMRS 125-162		175	35			158	27		12	19				800

Runout T in accordance with IT3, DIN ISO 286 T1 *n_K: Number of clamping elements = 4* *Further sizes on request*

The connecting components are to have a 25° introductory chamfer. The start of the chamfer should be 4 % over the outer diameter D_A of the nut (special hook wrench on request)

The MMRS precision labyrinth seal groove nut with integrated laminar spring steel rings forms a non-contact seal together with a suitably matched housing or with a seal ring nut of the MD series (see page 86, Figs 7.10 and 7.12 Application examples). While the labyrinth groove nut rotates with the shaft, the spring steel rings remain fixed, whereby they are preloaded radially outwards by the housing. The MMRS locknut is used in particular with single-row IBC precision 60° ball screw bearings and in precision bearing units.

The free space between the bearing and the groove nut should be filled with the same grease as that used in the rolling bearings. The sealing area of the labyrinth groove nut has already been lubricated with BEARLUB GH62 grease, which has proved its worth with ball screw support bearings.

7.4 IBC precision components - application examples

Locking of a radially locking precision locknut through spacer in the housing. Pillow block unit on request.

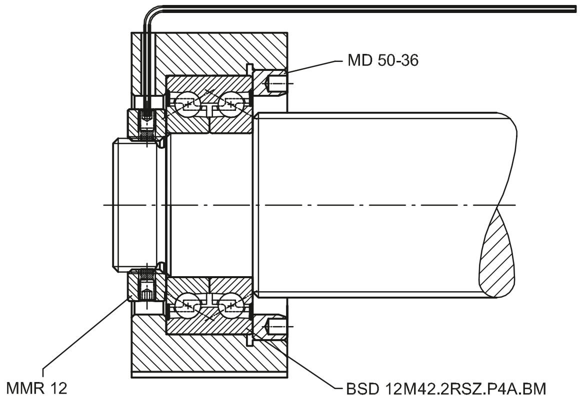


Fig. 7.7: Bearings for a ball screw (BS) with components from the IBC modular system

Bearing designation	Precision locknut MMR	Precision seal ring locknut MD
BSD 10M34	MMR 10	MD 40-26
BSD 12M42	MMR 12	MD 50-36
BSD 15M45	MMR 15	MD 50-36
BSD 17M47	MMR 17	MD 55-40
BSD 20M52	MMR 20	MD 55-40
BSD 25M57	MMR 25	MD 70-50
BSD 30M62	MMR 30	MD 70-50
BSD 30M72	MMR 30	MD 80-60
BSD 35M72	MMR 35	MD 80-60
BSD 40M75	MMR 40	MD 80-60
BSD 40M90	MMR 40	MD 95-76
BSD 50M90	MMR 50	MD 95-76
BSD 50M110	MMR 50	MD 120-99

Table 7.4: Possible combinations from the IBC construction kit modular system

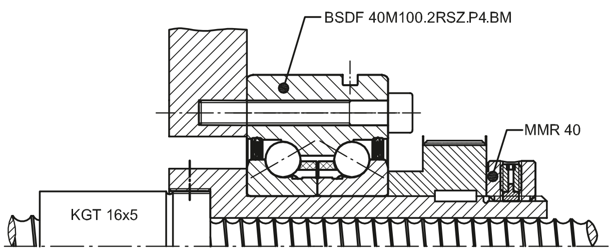


Fig. 7.8: Bearing of driven ball screw nut 16 x 5 via adapter and double-row precision ball screw support bearing BSDF 40M100.2RSZ.P4.BM preloaded with a precision locknut MMR 40

Fig. 7.9: IBC precision locknut MMR series

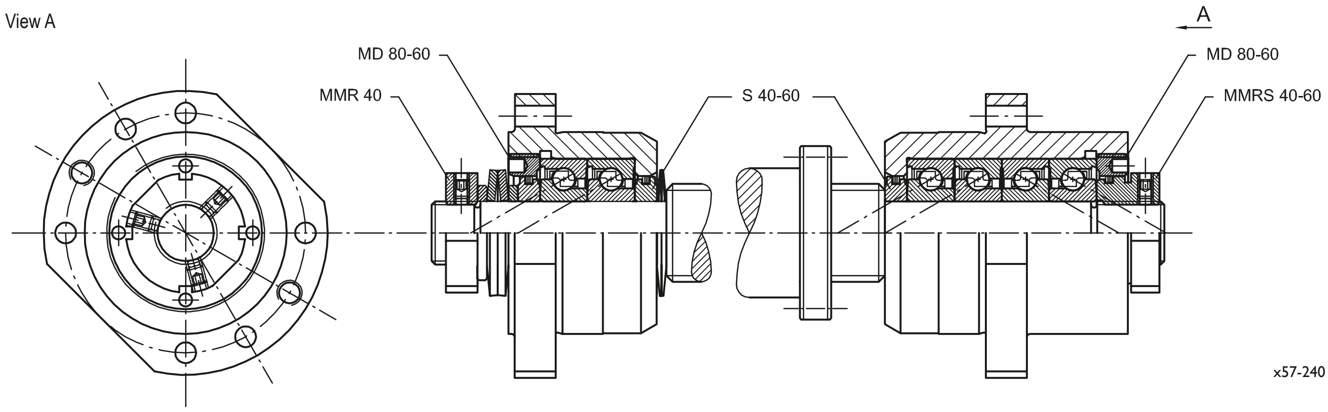


Fig. 7.10: Ball screw with bearings on both sides, preloaded by springs, with labyrinth seals and radially locking precision locknuts

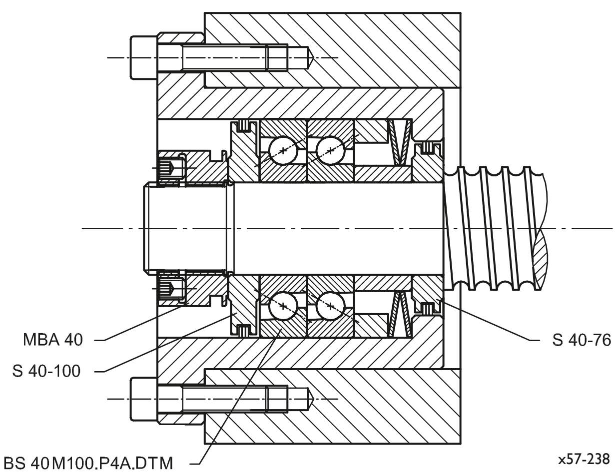


Fig. 7.11: Sealing of a spring-preloaded floating bearing at a ball screw with two labyrinth seals of the S series

Fig. 7.12: Compact combination of precision seal ring locknut MD with outer thread to set the bearing outer rings and precision labyrinth groove nut MMRS to preload the inner rings and simultaneously the self-locking seal

8. Recommendations for assembly and mounting

8.1 Mounting information IBC precision 60° ball screw support bearings - BSD and BSDF series

The following chapter lists a number of mounting examples for the BSD and BSDF series:

Mounting of a double-row precision 60° ball screw support bearing, BSDF series, in a housing

IBC provides a suitable range of components containing precision locknuts of the MD series with outer thread to fix the bearing outer ring and additionally precision locknuts that can be locked radially or axially to preload the bearing inner rings. In this way, rapid and secure mounting in the housing can be achieved.

The MD nut should be secured mechanically or with a special adhesive after it has been tightened up.

The application example shows in Fig. 8.1 a double-row precision 60° ball screw support bearing BSD 12M42.2RSZ.P4.BM, secured with a precision seal ring locknut MD 50-36 and a precision locknut MMR 12. Optionally, a precision pillow block unit with housing of this type can also be ordered as a complete item under the designation BSPB-M 12 D 32.M. See section 5.2.2.

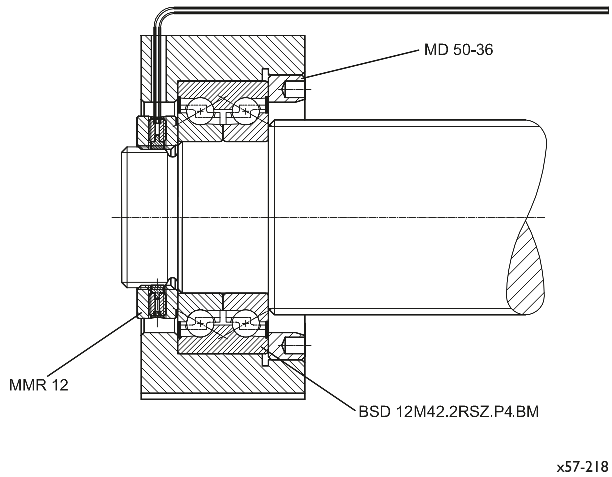


Fig. 8.1: Mounting of a precision 60° ball screw support bearing in a compact pillow block housing

Mounting of a matched bearing set of the BSDF...DBM-2 series

The bearing in Fig. 8.2 has been fixed into a housing fit in which the ball screw nut is "floated in". Screws to be used, in accordance with DIN 912 strength class 10.9.

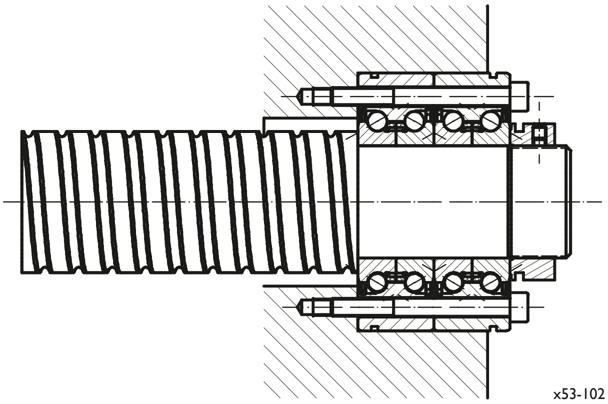


Fig. 8.2: Mounting of a BSDF...DBM-2

Mounting of a double-row precision 60° ball screw support bearing of the BSDF series

Fig. 8.3 shows the mounting of a double-row precision 60° ball screw support bearing of the BSDF series. In this case the aligning of the ball screw spindle is achieved by axial movement of the ball screw nut.

The ball screw nut has already been mounted on a travelling table. The bearings at the front side of the housing are only attached lightly, then the table with the ball screw nut is gradually brought up to the bearing. In this way the bearing automatically aligns radially with respect to the ball screw nut. In this condition, the screws should be tightened up alternately between the screws on each side.

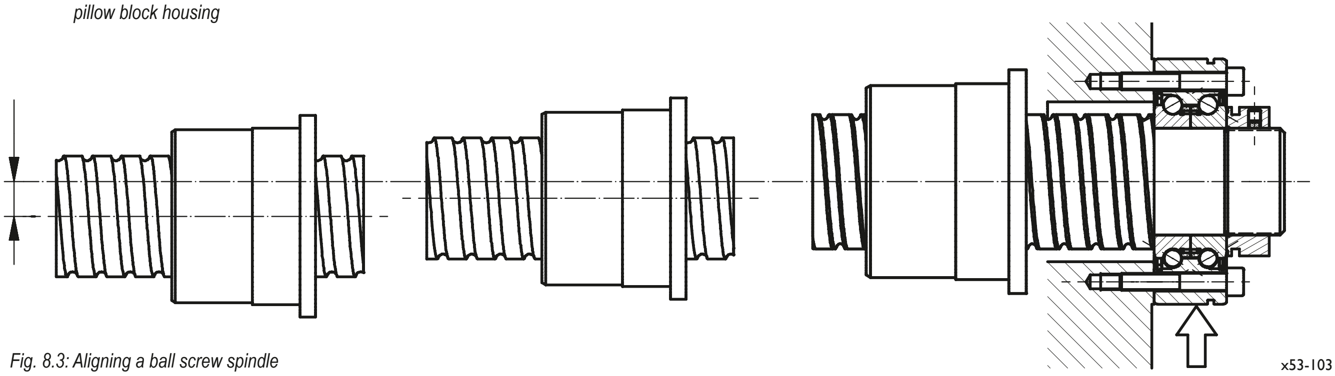


Fig. 8.3: Aligning a ball screw spindle

8.2 Mounting and preloading of IBC precision 60° ball screw support bearings by means of IBC precision locknuts

IBC precision locknuts are used for the precise attachment of rolling bearings or bearing units, especially in the machine tool sector or for other precision machines. The following section covers the determination of tightening torques and handling during mounting.

Preparation

Pay attention to a clean mounting environment and to the cleanliness (free of chips, burrs and damage) of the components to be mounted, such as rolling bearings, spacers, shaft, housing and precision locknuts.

Checking the adjacent parts

In order to ensure the interference fits and the rectangularity of the bearing seal after mounting, the connecting parts should be checked for dimensional compliance and roughness. Check spacers for parallelism (< 2 µm). The shaft and nut thread depth must be checked before mounting to ensure sufficient thread for screwing in.

Tightening torques for precision locknuts

Regarding the tightening torques, it is necessary to make a distinction between the tightening torque of the locknuts and the tightening torque of the locking devices. If the locknut comes loose due to frequently, strongly alternating loads, the locknut may not be further tightened, but instead the tightening torque of the locking devices can be increased as required. See table 7.2 on page 77, maximum permissible tightening torques of the locking devices. The maximum breakaway torque can be found from formula 8.1.

$$M_L = M_D + M_s \qquad \text{[Nm]} \quad [8.1]$$

$$T = T_a + M_D \qquad \text{[Nm]} \quad [8.2]$$

M_L	breakaway torque	[Nm]
M_D	minimum required preload torque	[Nm]
M_s	breakaway torque from the locking torque	[Nm]
T_a	tightening torque to mount the rolling bearing	[Nm]

It can be seen that an increase in the breakaway torque results from an increase in the tightening torque of the locking devices.

The locknut tightening torque T from formula 8.2 can be determined from the total of the required tightening torque to mount the rolling bearings T_a and from the preload torque of the rolling bearings M_D.

A light slide fit is recommended for precision 60° ball screw support bearings (see page 35). As a result, the tightening torque T_a for the pressing-in of the rolling bearing can be ignored. This is not the case for shafts with transition fits or interference fits, such as those used in spindle bearings, for example. Detailed information is given in our catalogue **High Precision Locknuts TI-I-5020.1 / E**.

Calculation of the required preload torque

The minimum required preload torque M_D for the rolling bearings depends on the ground-in nominal load F_v of the rolling bearing, the thread diameter and the bearing arrangement. In addition, the fit overlap at the inner ring has an important influence on the preload in the mounted condition. The minimum required preload torque M_D can be determined approximately with the following formula:

$$M_D = K_u \cdot d_{thread} \cdot F_v \cdot K_{FV} \cdot 10^{-4} \qquad \text{[Nm]} \quad [8.3]$$

M_D	minimum required preload torque	[Nm]
K_u	series-dependant increase factor	

d [mm]	K_u
10 … 30	2.8
35 … 75	2.6
80 … 150	2.4

d_{thread}	thread diameter of the precision locknut	[mm]
F_V	precision locknut nominal preload ground-in	[N]
K_{FV}	constant of the bearing arrangement	

Overview of the K_{FV}-values for various bearing arrangements

<>	DB	1.00	<<<<<<>	HBT	1.90
<<>	TBT	1.36	<<>>	QBC	2.00
<<<>	QBT	1.57	<<<>>	PBC	2.42
<<<<>	PBT	1.71	<<<<>>	SBC	2.72
<<<<<>	SBT	1.82	<<<<<>>	HBC	2.95
<<<>>>		3.00	<<<<>>>>		4.00
<<<<>>>		3.44	<<<<<>>>>>		5.00

In order to prevent settling phenomena, it is recommended that the tightening up of precision locknuts or cap screws is done to twice the tightening torque T, then they are to be loosened and subsequently tightened up again to the minimum required preload torque M_D.

8.3 Mounting of asymmetrical IBC precision bearing units

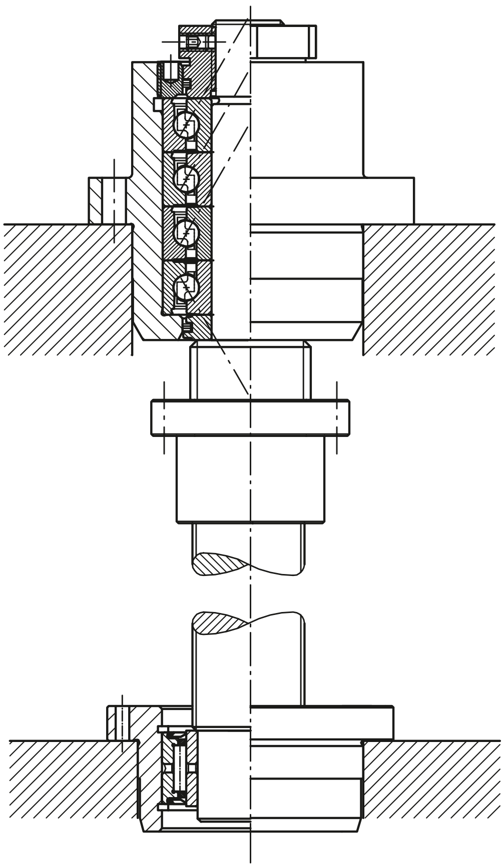
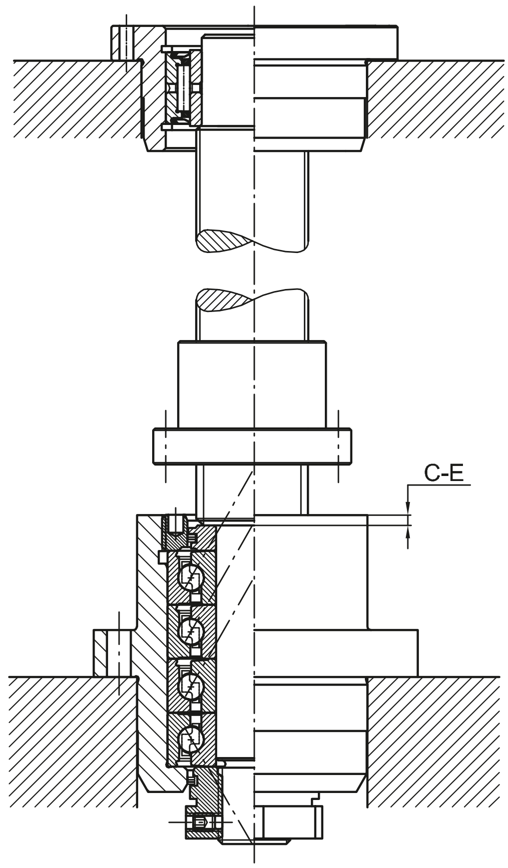


Fig. 8.4: Precision standard bearing unit BSBU-M 30 QB 98.QBTM



x57-215

Fig. 8.5: Precision standard bearing unit BSBU-MI 30 QB 98.QBTM

Depending on the machine design and optimization of the assembly, a locating bearing unit can be positioned either above or below. For the standard case, Fig. 8.4 shows the bearings, the labyrinth seal and the MMRS groove nut.

When mounting precision bearing units, if required, the MMRS labyrinth groove nut can be exchanged with the S labyrinth seal, which is in the precision flange units opposite. The same also applies to the precision pillow block units of the BSPB-M series. This is advantageous if there is a second precision pillow block unit at the other end and the orientation of the machined edge is to be maintained.

In the installation situation illustrated above, the labyrinth groove nut and seal in the precision locating bearing unit were exchanged compared to the standard installation shown on the left. If required by the user, the inverted arrangement can also be ordered specifically.

Prefix MI = integrated nut - inverted mounting

8.4 Pretensioning of ball screw spindles with IBC precision locknuts

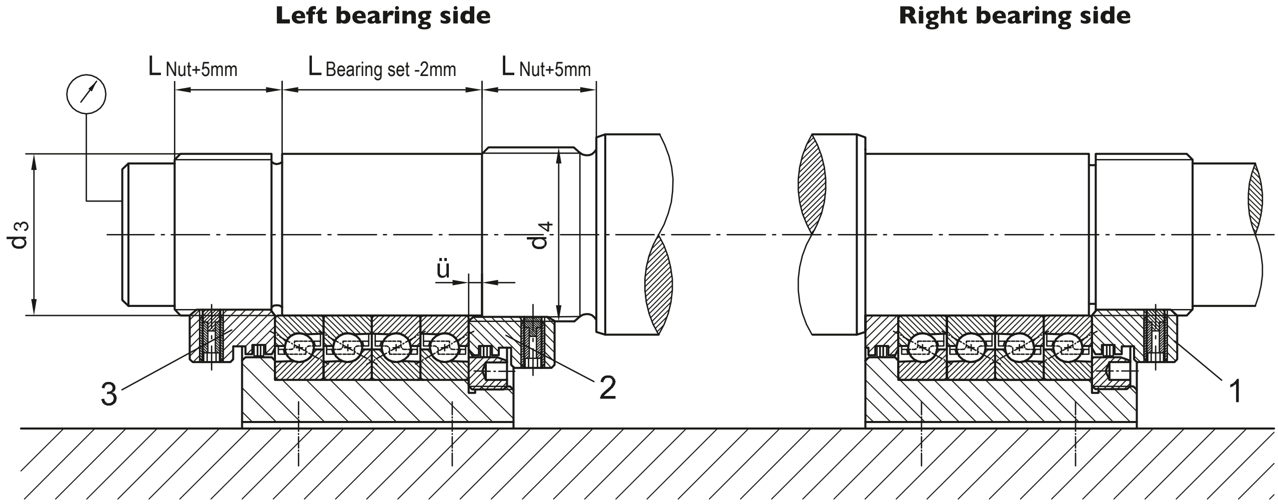


Fig. 8.6: Pretensioning of ball screws with integrated locknuts of the MMRB series

x57-201

Application with two locating bearings on a pretensioned ball screw spindle

Two IBC precision locknuts with integrated labyrinth seals are used on the pretensioned side. The precision locknut on the inside should be 5 mm larger in the thread diameter. For example, MMRS 30-60.Q2 and MMRS 35-60.Q2 are used for the bearings of the BSPB-M 30 Q 50 or BSBU-M 30 QB 98 series.

Procedure when pretensioning the spindle

1. The bearing unit that is not to be pretensioned is aligned, screwed in, located , and the precision locknut 1 (see Fig. 8.6) is preloaded with the tightening torque M_D as given on page 84.
2. At the bearing unit facing it, the screws in the foot of the precision pillow block unit or at the screw-on flange are aligned and tightened up minimally.
3. The precision locknuts 3 and 2 (see Fig. 8.6) must be tightened up on alternate sides. Initially they are tightened up lightly, and then more tightly and on alternate sides, and finally the precision locknut 2 is applied with tightening torque M_D.
4. The ball screw of the first side to be mounted with regard to the pretensioning side is moved to provide coaxial alignment of both bearing units. When doing so, the contact surface of the precision bearing unit on the pretensioning side that had only been done up lightly then aligns itself automatically.
5. Next, the screws at the foot of the precision pillow block unit or in the screw-on flange of the precision flange unit, as applicable, to be pretensioned are tightened up fully. After that, the predrilled pinholes are reamed and pinned.
6. In the next step, the starting position (zero value position) is determined on the pretensioning side. The precision locknuts 2 and 3 are loosened and the precision locknut 3 is tightened up minimally until the first resistance is felt.
7. Using a dial gauge, the position of the precision locknut 3 is checked. After that, it is tightened up further in two steps
   - for medium bearing preload by 20 µm,
   - for high bearing preload by 30 µm.

   In the next step the precision locknut is tightened up further to the amount to be pretensioned while checking with a dial gauge until the set pretensioning amount has been reached.
8. After that, the precision locknut 3 is locked and secured by increasing the tightening torque of the locking devices in steps up to the set value.
9. Finally, the precision locknut 2 is tightened up in stages with tightening torque M_D against the bearing package and locked.

When selecting the pretensioning rate, bear in mind that experience in its application is advisable. Excessive pretensioning increases the load on the outer bearings and insufficient pretensioning increases the load on the inner bearings.

Pretensioning and preloading of spring-preloaded spindles and precision bearing units

In applications that lead to a greater thermal expansion, spindles and precision 60° ball screw support bearings are preloaded with springs via separate locknuts of the MMRB series. The preloading and hence the desired stiffness are set via the deflection of the disc springs. A combination of the two types is possible. On page 100 two specification drawings show the layout principle of these precision flange and pillow block units. The details can be agreed upon between the customer and IBC with the help of the specification drawing.

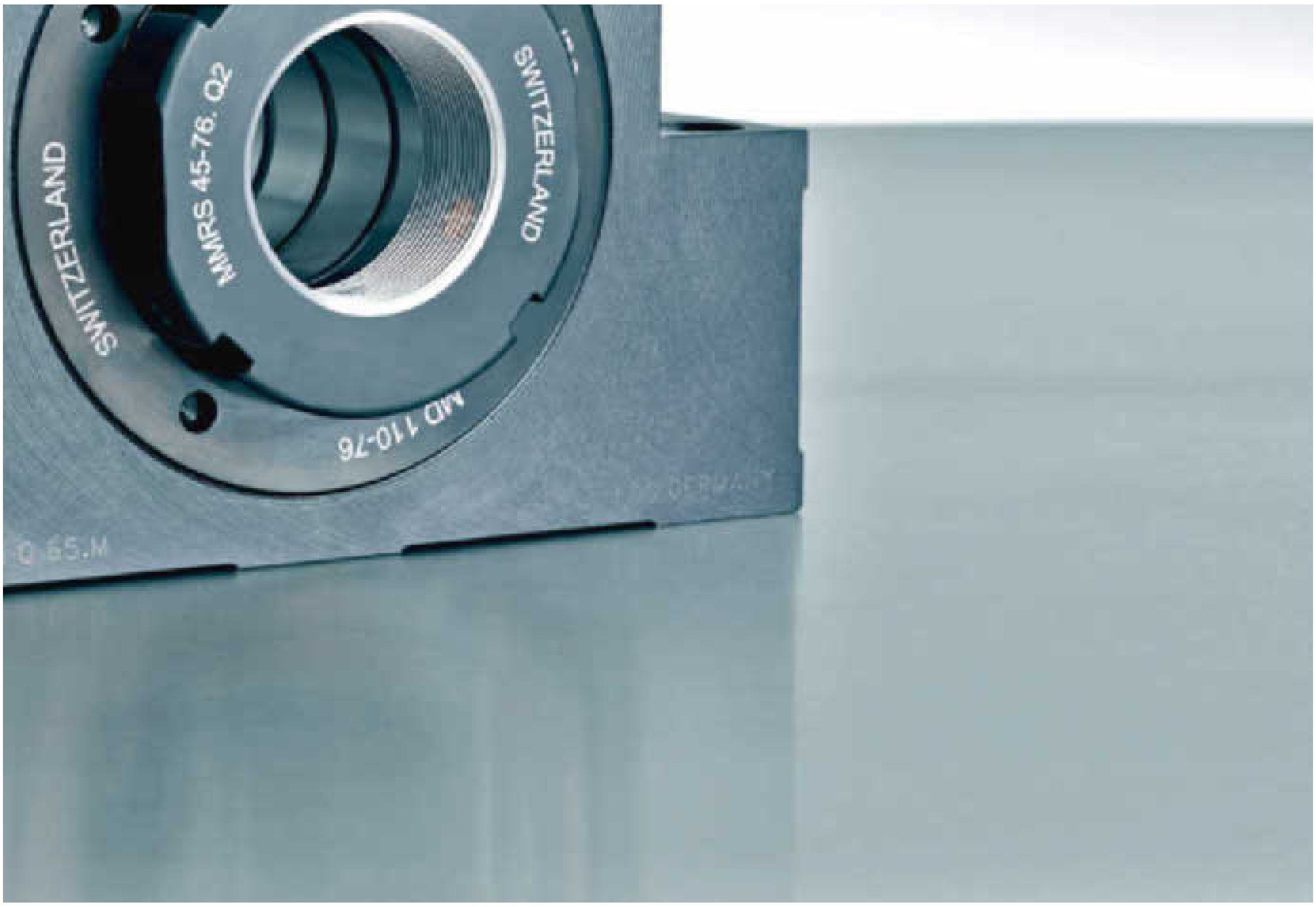


Fig. 8.7: Two IBC precision pillow block units BSPB-M 45 Q 65, which can be aligned at a locating edge for the pretensioning of the ball screw spindle

8.5 Locating-locating bearing arrangement for ball screw axes

In the case of feed axes, which tend to move slowly or seldom, locating bearings are used on both sides for reasons of stiffness and to increase the critical speed of rotation, the spindle is pretensioned via these bearings.

Symmetrically arranged precision bearing units are mostly used in the case of horizontal axes. Asymmetric precision bearing units are used in vertical axes, since greater forces need to be taken up in the main direction of the load if the machine does not have any weight compensation function.

Locating-locating bearing combinations are possible both with precision flange and pillow block units. With pillow block units there is also the option to use special housings with an integrated motor flange.
(For examples see page 62 ff.)

Fig. 8.8: IBC precision special pillow block units with integrated locknuts for the pretensioning of a ball screw

8.6 Locating and spring-preloaded assemblies

The critical rotating speed of the spindle can be increased with spring-preloaded units. This is achieved by reducing the bearing clearance at the floating bearing side and by light pretensioning of the spindle. A spring-preloaded bearing arrangement is recommended also for higher travelling frequencies that develop greater heat and a locating-locating bearing arrangement is to be preferred.

The desired preload can be set with the spring deflection. Selecting the appropriate spring rate allows the thermal expansion of the spindle to be taken up by the spring package without any loss of the preload and the stiffness of the spindle is kept virtually constant.

In the case of spring-preloaded ball screw shaft ends in accordance with Figs 8.9 and 8.11 a loose shaft fit in accordance with g4 or g5 is selected, since here the thermal expansion in length is achieved within the bearing inner rings.

In practice, combinations of flange and pillow block units can also be used. In these cases the spindle ends can be the same.

Floating bearing units that can be spring-preloaded are supplied with a preload set PLS, consisting of spacers, cup springs and a precision locknut.

The following installation examples show applications with flange and pillow block units. The same machined locating edge is used in the pillow block units in Fig. 8.11.

Spring-preloaded units with floating bearing function for light pretensioning of the spindle

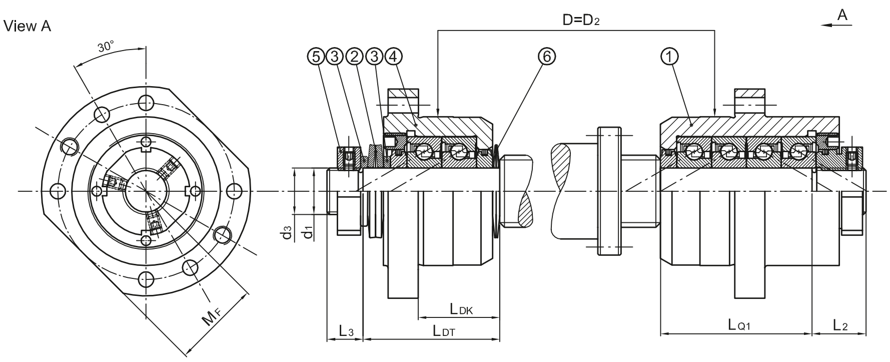


Fig. 8.9: Ball screw held in bearings on both sides with BSBU-M…Q + BSBU… DB… DT + PLS, with a floating bearing seat that can be pretensioned and preloaded via lockable nuts

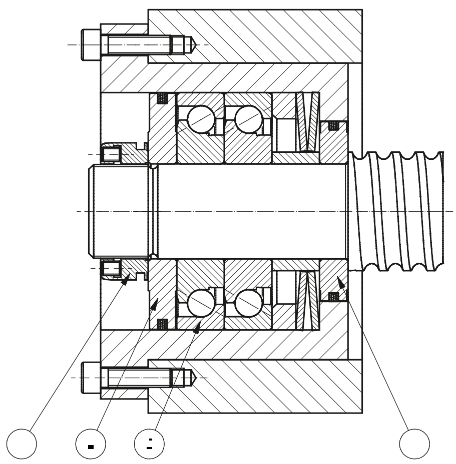


Fig. 8.10: Spring-preloaded assembly with floating bearing function in the housing; Bearing sealed via labyrinth seals of the S series

Spring-preloaded bearing unit with floating bearing function for light pretensioning of the spindle with a load reduction at the locating bearing unit

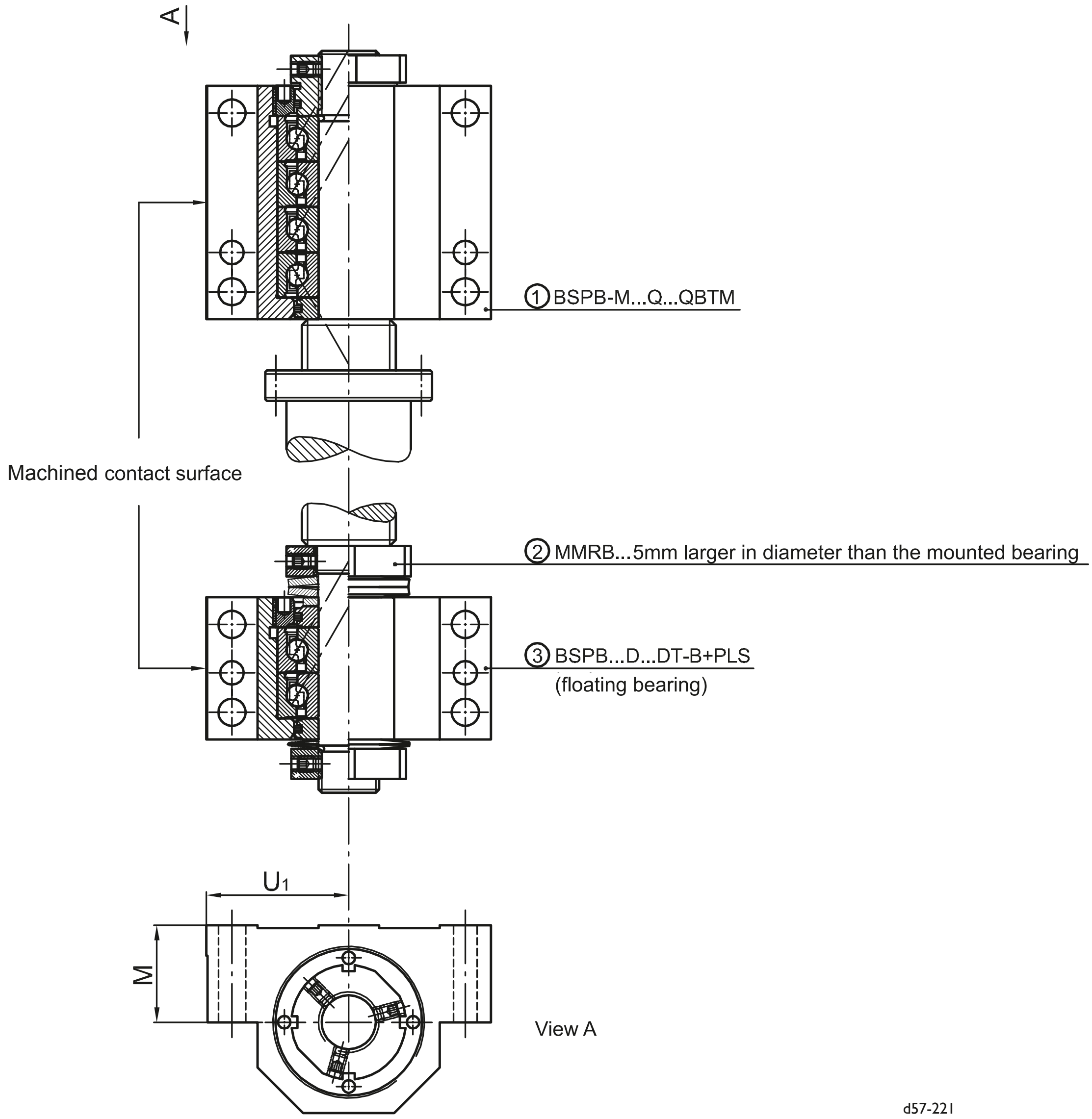


Fig. 8.11: Pillow block combination for a vertical arrangement, consisting of fixed locating bearing BSPB-M..Q..QBTM and spring-preloaded floating bearing BSPB..D..DT-B + PLS with integrated locknut MMRB

The illustration shows the bearings for a long, vertically arranged ball screw that is heavily loaded on one side. Three precision 60° ball screw bearings take up the main load in the upper fixed bearing unit. This is supported by two bearings in a tandem arrangement, which are adjusted to the set pressure preload after the fixing of the lower housing with precision locknut 2 and then locked in this position. A relatively high proportion of the load is borne by the bearings in the lower housing and reduces the load that acts on the three precision locating bearings within the upper unit. In the floating bearing housing the bearings have been rotated by 180° compared to the previous standard illustration, which is shown by a B in the suffix (.. DT-B). The lower precision locknut is only tightened minimally and locked. It holds the lightly spring-preloaded lower labyrinth seal.

8.7 Grease distribution run

Grease distribution run

A grease distribution run should be carried out before bringing high precision rolling bearings into service; if possible this running-in should include temperature monitoring.

Different scenarios for the grease distribution run have been proven and tested; they do, however, depend on the test rig used. In high precision rolling bearings that are firmly preloaded against each other, the preload may accidentally and significantly increase during the grease distribution run due to thermal expansion of the inner ring. During the first few minutes of the running-in process, or after restarting with a cold spindle, the inner ring will heat considerably faster and therefore expand more than the outer ring. For a short period of time, the preload will therefore increase, sometimes to an extreme degree, until temperature balance is regained via heat transfer to the outer ring.

This effect is especially critical for bearings in an X-arrangement. It also applies to hybrid bearings, because although their ceramic rolling elements have a smaller coefficient of expansion, they also have reduced thermal conductivity and higher stiffness. Spring preloaded bearing arrangements place slightly fewer demands on the grease distribution run. Due to the axial flexibility of the spring adjustment, they are able to compensate for the deformation of the inner ring.

Provided that a fixed speed is used, the heat generated may be controlled via the ratio of duty cycles to rest periods, whereby the former are extended by degrees and the latter shortened, until steady temperature conditions exist for continuous operation. During this process, cooling phases should always be introduced as soon as the maximum temperature of 60-70 ºC is reached. There will come a point at which the temperature steadies, as soon as the excess grease has been displaced from the raceway, but it will then slowly start to fall.

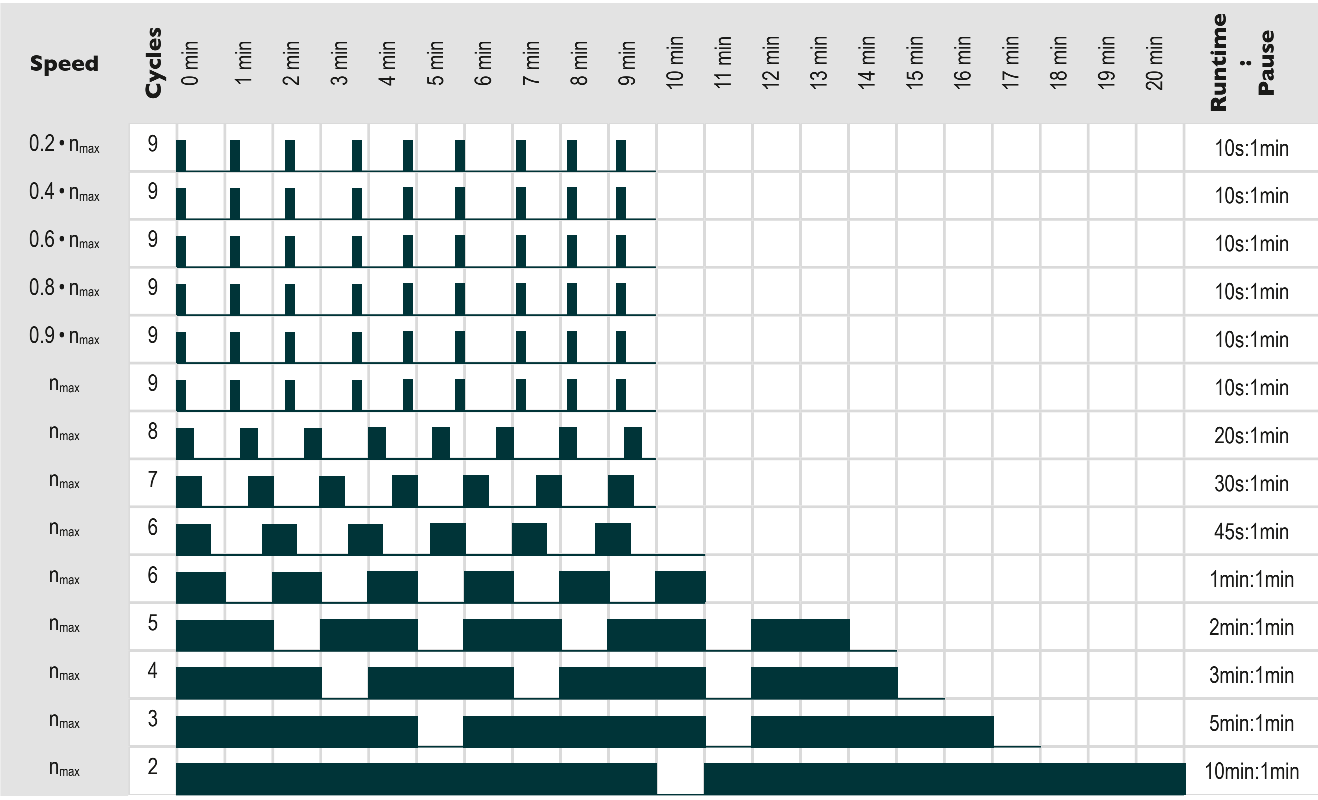


Diagram 8.1: Repeated, brief, progressive grease distribution run with increasing time intervals at the specified rotational speed

9.1 CAD user support

In order to make your CAD design work easier, we would be glad to support you with 3D elements on the basis of stp or iges files. The required files can be requested from us via e-mail at cadkomponenten@ibc-waelzlager.com

The following shows a small selection of these files:

BS 25M62.2RSZ.stp

ACC-BS 50M100.P4A.stp

BSDF 17M62.stp

BSBU 35 DB 98.stp

BSBU-M 35 DB 128.M.stp

BSPB 30 Q 50.stp

BSPB-M 30 Q 50.stp

BLPB 20 N 32.stp

MMRS 60-99.stp

MD 80-60.stp

MMRB 55.Q.stp

MBA 40.stp

MBC 160.stp

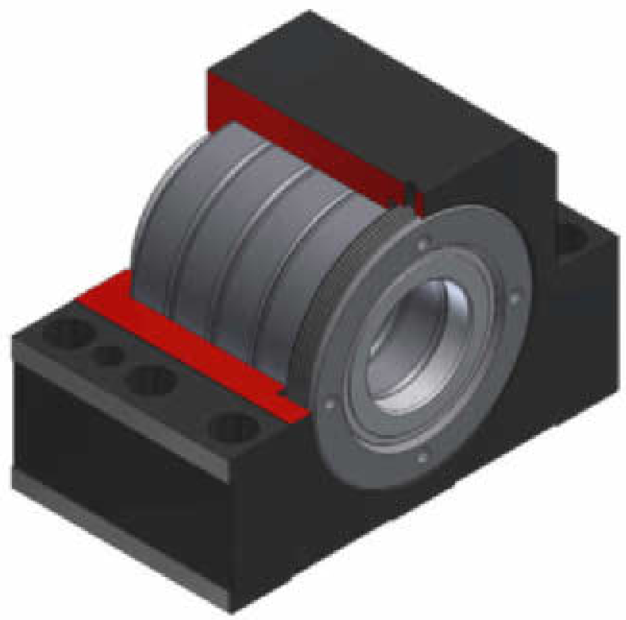


Fig. 9.1: 3D model of a precision pillow block unit - BSPB series

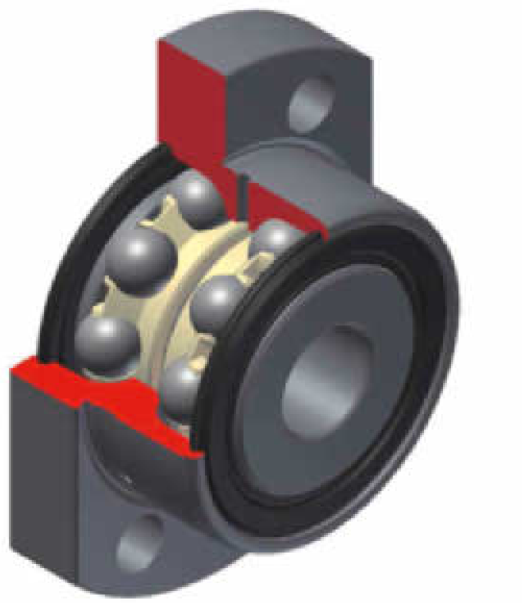


Fig. 9.2: 3D model of a double-row precision 60° ball screw support bearing - BSDFA series

9.2 Checklist for bearing specifications

Operating conditions dynamic:

Load case	**1**	**2**	**3**
Axial Load [N]			
Radial Load [N]			
Speed [min^{-1}]			
Time component [%]			

❑ Load in +/- axis direction half of the time each

❑ Load spectrum: Setup enclosed

Static loading: ________________ N

desired bearing configuration:

❑ Bearing sets

❑ Flange unit

❑ Pillow lock unit

❑ cross-section drawing of the application

Load Conditions:

❑ Inner ring rotates (driven shaft)

❑ Outer ring rotates (nut driven)

❑ Load rotates with inner ring

❑ Load rotates with outer ring

❑ Load direction fixed ❑ alternating

Bearing combination:

❑ Bearings one-sided

❑ Bearing locating, floating

❑ Bearing locating, spring-preloaded floating bearings

❑ Bearings on both sides, locating

❑ Bearing of the ball screw nut

Adjacent parts:

Ball screw nominal diameter: ________________ mm

Ball screw pitch: ________________ mm

Bearing seat diameter: ________________ mm

Seat diameter tolerance: ________________ mm

Mounting position: ❑ vertical ❑ diagonal
❑ horizontal

Temperature in operation: ________________ °C

Ambient termperature: ________________ °C

Lubrication: ________________

Working life to date: ________________ h

desired: ________________ h

Other: ❑ 3D-elements of the following types desired:

____

____

____

Rolling bearings used so far:

Designation: ________________

Preloading [N]: ________________

Manufacturer: ________________

Annual demand: ________________ pieces

Supply: ❑ Direct from the manufacturer ______________________________________

❑ via a retailer ______________________________________

Company: ______________________________

Contact person: ______________________________

Position: ______________________________

Telephone: ______________________________

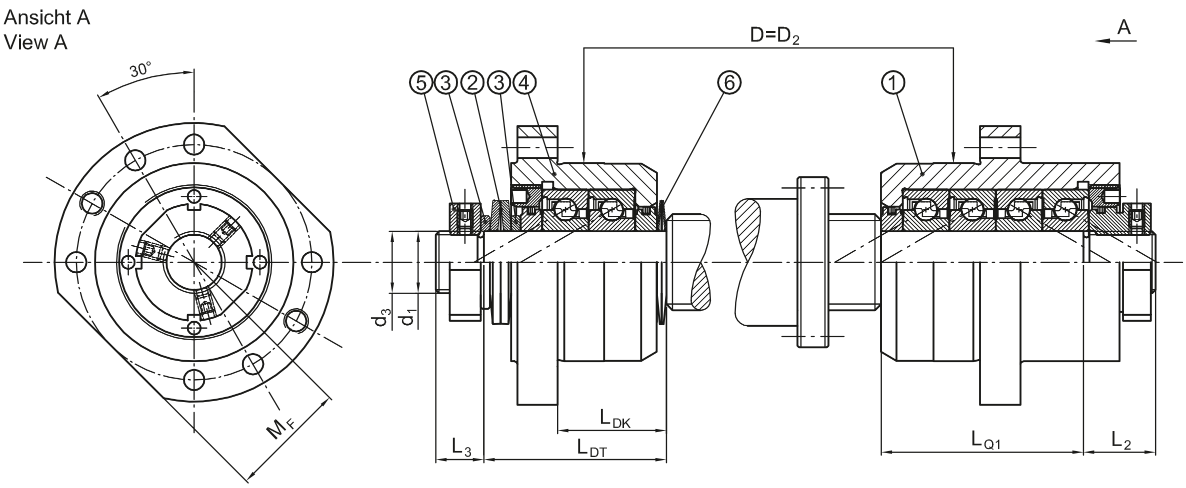
Fax: ______________________________

E-Mail: ______________________________

Place, date and name: ____

9.3 Specification drawings for precision locating bearings and spring-preloaded assemblies

Beidseitig gelagerter Kugelgewindetrieb, federvorgespannt, mit sicherbaren Spannmuttern.
Ball screw supported at both ends, spring preloaded, with securable locknuts.



d_1	d_3	D=D_2	L_2	L_3	L_{DT}	L_{Q1}	M_F	L_{DK}

Pos.	Bezeichnung / Designation	Menge / Quantity
6	Tellerfeder / Disc Spring	2 Stück / Pieces
5	sicherbare Spannmutter / securable Locknut	1 Stück / Piece
4	BSBU......DB......DT	1 Stück / Piece
3	Distanzring / Spacer DS ......x......x 4	2 Stück / Pieces
2	Tellerfeder / Disc Spring	2 Stück / Pieces
1	BSBU-M......QB......	1 Stück / Piece

Techn. Daten siehe Katalog
Techn. data please see catalog

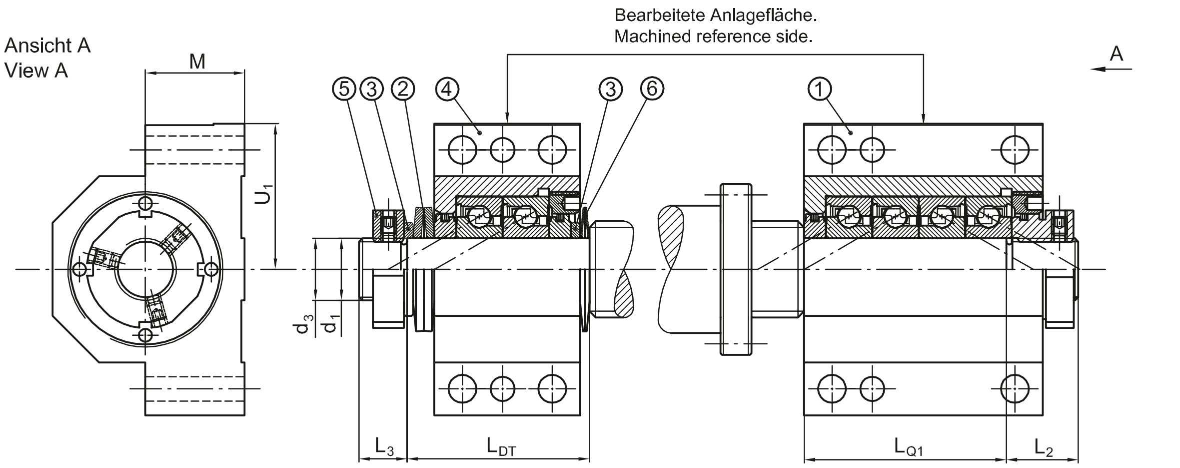
Schutzvermerk nach DIN 34 beachten | MAßSTAB/SCALE
Erstellt :
Geprüft :
070603

IBC WÄLZLAGER GMBH
Wetzlar–Germany

Bezeichnung, Designation
BS–Lagerung (Schema) / BS–Support (Scheme)
BSBU-M..QB... + BSBU..DB...DT + PLS

Zeichnungsnr., Drawing no.
x57-104

Beidseitig gelagerter Kugelgewindetrieb, federvorgespannt, mit sicherbaren Spannmuttern.
Ball screw supported at both ends, spring preloaded, with securable locknuts.



d_1	d_3	L_2	L_3	L_{DT}	L_{Q1}	M	U_1

Pos.	Bezeichnung / Designation	Menge / Quantity
6	Tellerfeder / Disc Spring	2 Stück / Pieces
5	sicherbare Spannmutter / securable Locknut	1 Stück / Piece
4	BSPB......D......DT	1 Stück / Piece
3	Distanzring / Spacer DS ......x......x 4	2 Stück / Pieces
2	Tellerfeder / Disc Spring	2 Stück / Pieces
1	BSPB-M......Q......	1 Stück / Piece

Techn. Daten siehe Katalog
Techn. data please see catalog

Schutzvermerk nach DIN 34 beachten | MAßSTAB/SCALE
Erstellt :
Geprüft :
070603

IBC WÄLZLAGER GMBH
Wetzlar–Germany

Bezeichnung, Designation
BS–Lagerung (Schema) / BS–Support (Scheme)
BSPB-M..Q... + BSPB..D...DT + PLS

Zeichnungsnr., Drawing no.
x57-105

MEMO

Projekt / Project : ____________________

Firma / Company : ____________________

Name / Name : ____________________

Telefon / Phone : ____________________

E-Mail : ____________________

IBC Wälzlager GmbH • 35528 Wetzlar-Germany • Tel.: +49 64 41 95 53-02 • Fax: +49 64 41 5 30 15
E-Mail: ibc@ibc-waelzlager.com

10. Overview of the IBC product range

IBC High Precision Bearings, see catalogue TI-I-5050.0 / E

IBC High Precision Cylindrical Roller Bearings, see catalogue TI-I-5050.0 / E

IBC Precision Angular Contact Ball Bearings for stub spindles, DTB series, see catalogue TI-I-5000.1 / E

IBC 40° Angular Contact Ball Bearings, see catalogue TI-I-4044.1 / E

IBC Double-row high precision 60° ball screw support bearings, BSDF series, see catalogue TI-I-5010.3 / E

IBC Cylindrical Roller Bearings, see catalogue TI-I-4010.0 / E

IBC Precision Locknuts, see catalogue TI-I-5020.1 / E

IBC Linear motion bearings, see catalogue TI-I-5011.2 / E

IBC ECO-Runner, see catalogue TI-I-7001.3 / E

IBC Telescopic-Runner, see catalogue TI-I-7005.2 / E