Brand of **NTN Group**

LINEAR MOTION: BALL BUSHINGS

INNOVATION AT YOUR PRODUCTION'S SERVICE

Movement. It is constantly changing. It is analysed, brought under control, guided and mastered with the aim of deriving maximum benefit. It is more than merely a concept. It is the very essence of our commitment, namely designing and innovating to deliver the perfect solutions to the issues and constraints of today and tomorrow.

There are thousands of us around the world masterminding and developing solutions to raise the bar on your production performance. Our world-leading brands (**NTN, BCA, BOWER** and **SNR**) are marketed worldwide and deliver the best-fit solutions for working together and building a more environmentally-friendly society. Follow our lead and use interaction, anticipation and adaptation as the keys to guiding and shaping the future of the manufacturing, automotive and aviation markets.

5.05 BILLION €* of turnover

22,000* employees

The local service of an international partner

117 Sales representations

72 Production sites

15 R&D centres

* March 2025

SNR ball bushings are universal machine elements that meet the constantly growing demands on the automation of assembly and manufacturing processes. NTN produces one of the widest product ranges of ball bushings.

SNR ball bush ings are used in many different applications, such as:

- Packaging and printing machines
- Special and general engineering
- Automation and assembly lines
- Wood and paper industry
- Semiconductor industry
- Medical engineering
- and much more

The different design types are adapted to the variety of applications.

Advantages:

- Wide range of design types
- Various standard and super ball bushings
- Wide range of linear units for standard and super ball bushings
- Standard. heatresistant and corrosionresistant versions
- Very high load ratings
- Optimal product selection according to the special requirements
- Ball bushings according ISO and JIS standard

This technical catalog provides an overview of our ball bushing range and forms the basis of our discussions with you – our customer.

CONTENTS

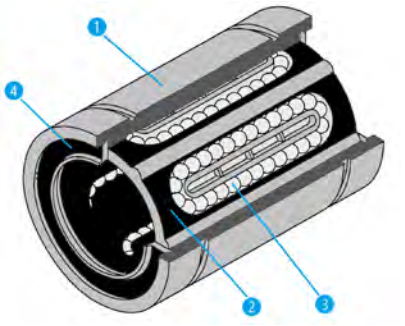
1 Basics of ball bushings

1.1 Design principles

Since ancient times, humans have had to deal with the problem of moving loads. These movements can be rotary, linear, or a combination of both. These movements can be found in all machines to this day.

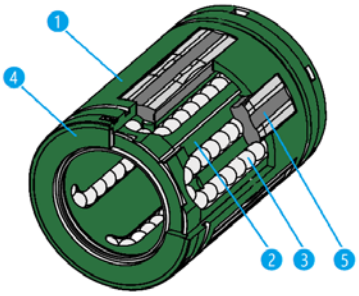
Starting with sliding bearings, rolling bearings have now become the standard. Ball bushings are an important variant of linear guides that have been established in industry since the first half of the 20th century.

Ball bushings perform linear movements on ground and hardened steel shafts. There are three basic design principles for ball bushings: standard ball bushings (Figure 1.1), super ball bushings (Figure 1.2), and ball sleeves (Figure 1.3).



1. Outer cylinder
2. Cage
3. Balls
4. Seal

Figure 1.1 — Structure standard ball bushings



1. Plastic body
2. Plastic cage
3. Balls
4. Seal
5. Raceway bar

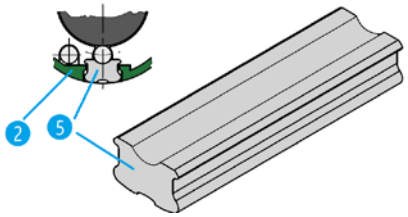


Figure 1.2 — Structure super ball bushings

1. Outer cylinder
2. Cage
3. Balls
4. Seal

Figure 1.3 — Structure ball sleeves

1.2 Features

1.2.1 Friction

The balls in the ball bushings move in a straight line on hardened and ground steel shafts. The contact surface with the steel shafts is a minimal point contact. This results in a minimal friction coefficient, which enables very smooth movements.

1.2.2 Lubricant requirement

Due to the minimal contact surface between the balls and the shafts, ball bushings require only very small amounts of lubricant for reliable operation.

1.2.3 Design types of ball bushings

Typical design typs of ball bushings are cylindrical (Figure 1.4) and flange type ball bushings (Figure 1.5).

Figure 1.4 — Cylindrical ball bushings and ball sleeves

Figure 1.5 — Flange type ball bushing

Cylindrical and flange type ball bushings are available in two different design lengths (Figure 1.6 and Figure 1.7).

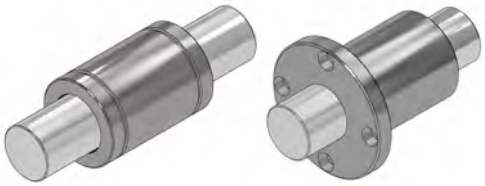


Figure 1.6 — Standard design length

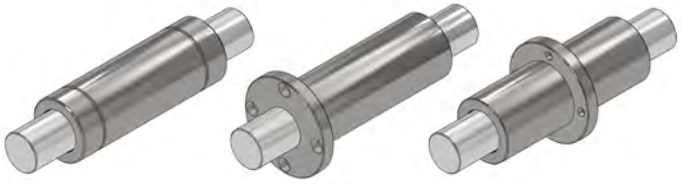


Figure 1.7 — Tandem version

In addition, cylindrical standard ball bushings in standard lengths and super ball bushings are available in closed (Figure 1.8) and open (Figure 1.10) versions, and standard ball bushings are also available in an adjustable version (Figure 1.9).

Figure 1.8 — Closed version

Figure 1.9 — Adjustable version

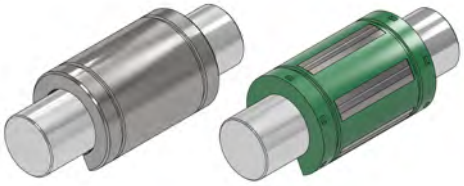


Figure 1.10 — Open version

1.2.4 Design types of linear units

Linear units are aluminum housings with integrated ball bushings as guiding elements. Linear units can be equipped with standard or super ball bushings. Linear units can be designed as single (Figures 1.11 and 1.14), tandem (Figures 1.12 and 1.15) or quattro versions (Figures 1.13 and 1.16) in closed and open designs.

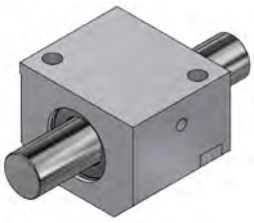


Figure 1.11 — Single linear unit, closed

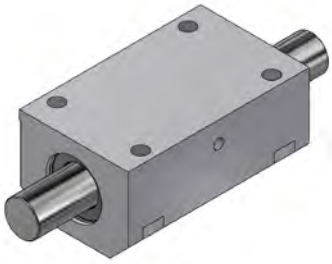


Figure 1.12 — Tandem linear unit, closed

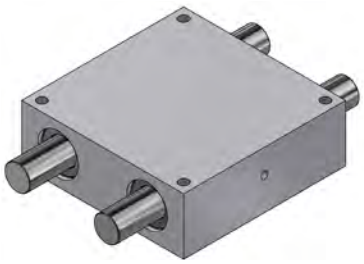


Figure 1.13 — Quattro linear unit, closed

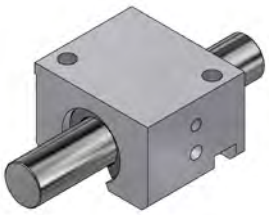


Figure 1.14 — Single linear unit, open

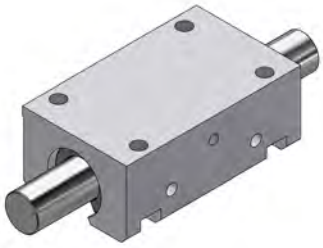


Figure 1.15 — Tandem linear unit, open

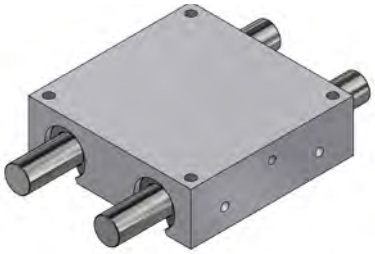


Figure 1.16 — Quattro linear unit, open

Closed and open single and tandem linear units are also available as adjustable versions (Figure 1.17).

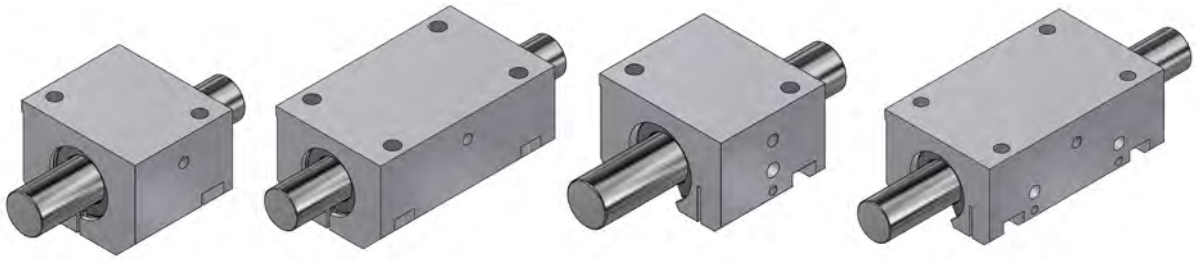


Figure 1.17 — Adjustable linear unit, closed and open

Linear units for lateral mounting are a special design. These are available as single linear units in an open version (Figure 1.18) and an adjustable open version (Figure 1.19).

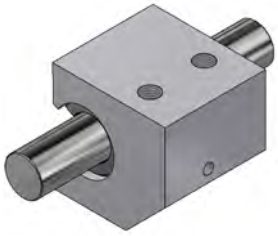


Figure 1.18 — Open linear unit for lateral mounting

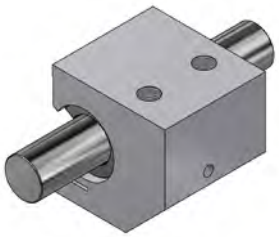
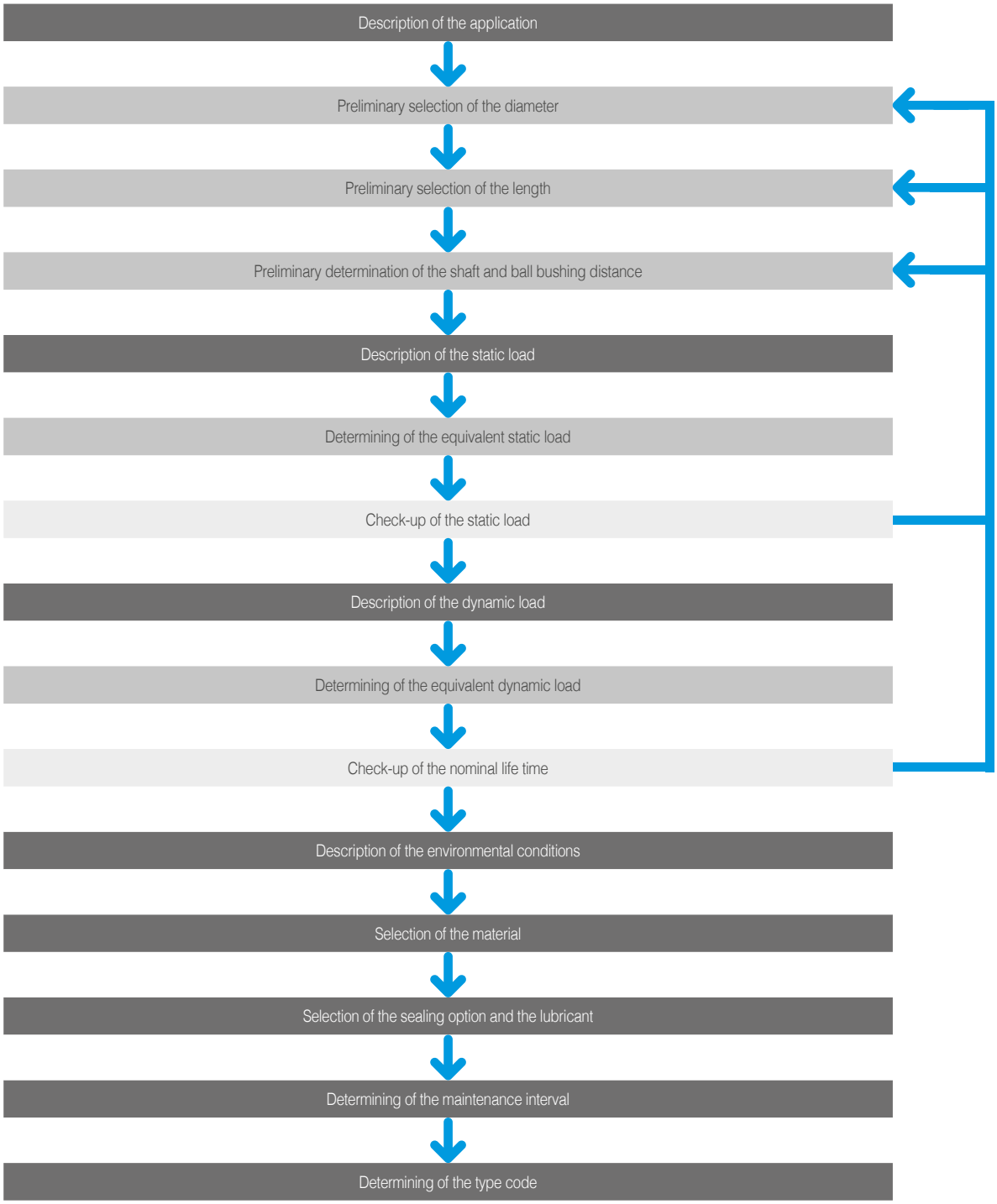


Figure 1.19 — Adjustable open linear unit for lateral mounting

1.3 Selection criteria



2 System technology

2.1 Definitions

Service lifetime L

The service lifetime L is the running distance that a component can handle before the first signs of material fatigue become apparent on the tracks or the rolling elements.

Nominal service lifetime L_{10}

The nominal service lifetime L_{10} is the calculated service life time of a single linear guide system or of a group of equivalent linear guide systems operating under equal conditions that can be reached with a probability of 90%, assuming the use of currently common materials of average manufacturing quality and common operating conditions.

Dynamic load rating C

The dynamic load rating C is the in size and direction constant, radial load that a linear bearing can theoretically withstand for a nominal service lifetime of $5x10^4$ m travelled distance (according to ISO 14728-1). When the calculation of the dynamic load rating is based on a nominal service lifetime of 10^5 m, the dynamic load rating for a nominal service lifetime of $5x10^4$ m is divided by the conversion factor 1.26.

Static load rating C0

The static load rating C0 is the static, radial load that corresponds to the middle of the highest-stressed contact area between rolling element and raceway of a calculated Hertz-type compression. The Hertz-type compression for the linear guide is, according to ISO 14728-1, between 4200 MPa and 4600 MPa and depends on the ball diameter and the osculation. This load leads to a permanent, total deformation of the rolling element that corresponds to a 0.0001 part of the rolling element diameter (according to ISO 14728-1).

2.2 Used standards

DIN ISO 10285	Rolling bearings – Sleeve type linear ball bearings – Boundary dimension and tolerances
DIN ISO 13012-1	Rolling bearings - Accessories for sleeve type linear ball bearings - Part 1: Boundary dimensions, geometrical product specifications (GPS) and tolerances for series 1 and 3
DIN ISO 13012-2	Rolling bearings - Accessories for sleeve type linear ball bearings - Part 2: Boundary dimensions, geometrical product specifications (GPS) and tolerances for series 5
DIN ISO 14728-1	Rolling bearings - Linear motion rolling bearings - Part 1: Dynamic load ratings and rating life
DIN ISO 14728-2	Rolling bearings - Linear motion rolling bearings - Part 2: Static load ratings
DIN ISO 24393	Rolling bearings - Linear motion rolling bearings - Vocabulary

NTN ball sleeves, SNR ball bushings, SNR linear units, and accessories comply with the RoHS Directive (EU Directive RoHS 2011/65/EU and 2015/863/EU and Regulation (EC) No. 1907/2006 (REACH).

NTN ball sleeves, SNR ball bushings, SNR linear units, and accessories are not listed in the Machinery Directive 2006/42/EC and are therefore not affected by the directive.

2.3 Intended use

NTN ball sleeves, SNR ball bushings, and SNR linear units are assemblies. NTN ball sleeves, SNR ball bushings and SNR linear units may only be used within the scope of the type-specific load data specified in the product catalog or supplementary technical calculations provided by NTN.

NTN ball sleeves, SNR ball bushings, and SNR linear units may only be operated and maintained by persons who are familiar with them and have been instructed in the hazards involved. This also includes reading and understanding this documentation in its entirety.

Any other or additional use is considered improper. The manufacturer is not liable for any resulting damage. The user bears the risk alone.

2.4 Safety instructions

The following safety instructions must be observed when using ball sleeves, ball bushings, and linear units:

- Use ball sleeves, ball bushings, and linear units only for their intended purpose.
- Ball sleeves, ball bushings, and linear units may only be used within the technical parameters permitted in the product catalog.
- Only products in a technically perfect condition may be used.
- No modifications may be made to ball sleeves, ball bushings, or linear units.
- Do not reach into moving parts.
- Ball sleeves, ball bushings, and linear units must not be moved to end stops.
- Use in safety-relevant applications is only permitted if such use is expressly specified in the product catalog or has been confirmed by NTN.
- Ball sleeves, ball bushings, and linear units may only be used under the environmental conditions described in the product catalog.
- Ball sleeves, ball bushings, and linear units may only be put into operation once it has been determined that the assembly or final product in which the ball sleeves, ball bushings, and linear units have been installed complies with the country-specific regulations, safety regulations, and standards applicable to the application.
- Only accessories and spare parts approved by the manufacturer may be used.
- Do not stand under suspended loads. In exceptional cases, defects may occur and, if the ball sleeves, ball bushings, and linear units are installed vertically, this may cause the mounted components to fall. Suitable protective measures in accordance with EN ISO 13849-1 must be taken to prevent this.
- The applicable regulations for accident prevention and environmental protection must be observed.
- Appropriate protective equipment must be worn during assembly and when working on ball sleeves, ball bushings, and linear units.
- Suitable and tested load handling devices that are adapted to the weight are to be used for lifting and transport.
- After all work on the machine, the safety devices must be re-assembled according to regulations and their function checked.
- Before start-up, ensure that all safety devices required for the application are available, properly installed and fully functional.
- Possible danger areas are to be clearly marked.

2.5 Selection of ball bushings

The selection of ball bushings, ball sleeves and linear units is determined by many factors related to the application:

- Loads
- Dynamic requirements
- Service lifetime
- Installation space
- Accuracy requirements
- Environmental conditions
- …

2.5.1 Preload

When mounting closed ball bushings with the fits specified in Chapter 3.2, these are generally in the range of slight radial clearance to slight preload. The possible range depends on the ball bushing series and the fit of the precision shafts.

The preload of ball bushings with adjustable clearance and open ball bushings must be carefully adjusted in accordance with the values for radial clearance specified in Chapter 3.2 so as not to exceed the permissible limit values for preload.

2.5.2 Static safety factor

To ensure the safe functioning of ball bushings, it is important that the local plastic deformation of the raceways and balls under load does not exceed the permissible limits.

The static safety factor is determined using formula 2.1. For operating conditions at elevated temperatures and for ball bushings made of special materials, influencing factors must be taken into account in accordance with the diagrams in Figures 2.1 and 2.2.

$$f_s = \frac{f_H \times f_T \times C_o}{F_{max}}$$ Formula 2.1

f_s	static safety factor
f_H	Hardness factor
f_T	Temperature factor
C_o	static load rating [kN]
F_{max}	maximum load [kN]

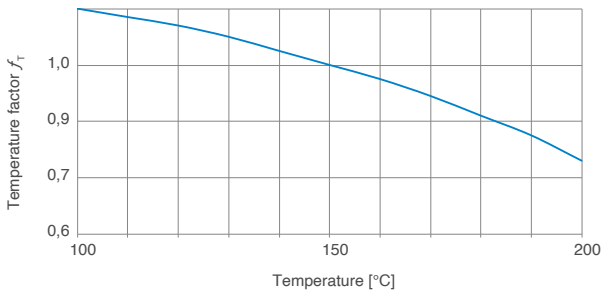


Figure 2.1 — Temperature factor f_T

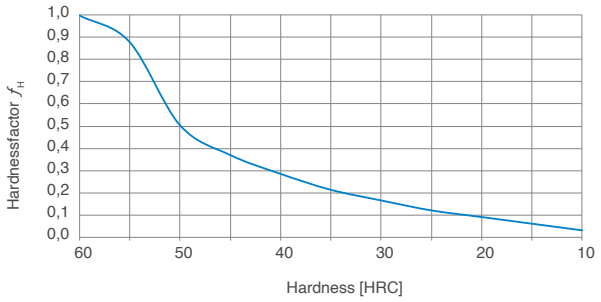


Figure 2.2 — Hardness factor f_H

Depending on the operating conditions, recommendations for the size of the static safety factor are summarized in Table 2.1.

Table 2.1 — Recommended values for the static safety factor

Operating condition	Static safety factor f_s
slow movement low loads no vibration and shocks	1,0…1,3
slow movement low loads light vibration and shocks	1,2…1,7
slow movement medium loads vibration and shocks	1,5…2,5
fast movement high loads vibration and shocks	2,0…4,0
fast movement high loads strong vibration and shocks	3,0…8,0

2.5.3 Service lifetime calculation

The raceways and balls of ball bushings are subjected to loads during operation that led to material fatigue. The nominal service lifetime L_{10} is calculated according to formula 2.2 as the total distance traveled by the ball bushing until material fatigue occurs in the raceways. Here too, the influencing factors f_T and f_H (Chapter 2.5.2) must be taken into account. When calculating the nominal service lifetime L_{10}, the load factor f_W must also be taken into account. Recommendations for the load factor are given in Table 2.2.

$$L_{10} = \left(\frac{f_T \times f_H}{f_w} \times \frac{C}{F_m} \right)^3 5 \times 10^4 \text{ m} \qquad \text{Formula 2.2}$$

L_{10} Nominal service lifetime [m]
f_H Hardness factor
f_T Temperature factor
f_w Load factor
C Dynamic load rating [kN]
F_m Mean dynamic load [kN]

Table 2.2 — Recommended values for the load factor f_W

Operating conditions	Velocity [m/s]	Load factor f_W
no or very low vibration and shocks	≤ 0,25	1,0…1,2
low vibration and shocks	0,25...≤ 1,0	1,2…1,5
medium vibration and shocks	1,0...≤ 2,0	1,5…2,0
strong vibration and shocks	> 2,0	2,0…3,5
Short stroke application		3,5…5,0

Depending on requirements, the nominal service life L_{10} can also be specified in hours L_h or number of cycles $L_{\#}$. Formulas 2.3 and 2.4 must be used for this purpose.

$$L_h = \frac{L_{10}}{2 \times s \times 60 \times n}$$

Formula 2.3

L_h	Nominal service lifetime [h]
L_{10}	Nominal service lifetime [m]
s	Stroke [m]
n	Stroke frequency (double-strokes) [min^{-1}]

$$L_{\#} = \frac{L_{10}}{2 \times s}$$

Formula 2.4

$L_{\#}$	Nominal lifetime (double-strokes) [cycles]
L_{10}	Nominal service lifetime [m]
s	Stroke [m]

3 Assembly

3.1 Transport and storage

Ball bushings and precision shafts are high-quality machine elements and must be handled with appropriate care. To avoid damage and pollution, they should remain in the protective film until installation. For longer storage, we recommend leaving the products in our transport packaging to prevent precision shafts from bendings.

Suitable and tested lifting devices must be used to handle longer and heavier precision shafts. There should be several support points over the length of the precision shaft to limit the bending.

During transport, ball bushings or linear units mounted on the precision shafts must be secured with e.g. cable ties to prevent them from moving on their own.

3.2 Assembly tolerances

Construction notes

Ball bushings are high-quality machine elements that have a significant influence on the accuracy and service lifetime of the entire system.

Assembly tolerances

When using closed ball bushings, the fitting dimensions of the precision shafts and the bore holes in the housing are decisive for the radial clearance of the ball bushing guides. Table 3.1 contains the recommended combinations of fits.

Table 3.1 — Recommended fits for closed ball bushings

	Shaft diameter		Housing diameter	
	Clearance fit	Transmission fit	Clearance fit	Transmission fit
BBE_, BBE_A, BBES_, BBES_A	h6	j6	H7	J7
BBE_L, BBE_LA, BBES_L, BBES_LA	h6	-	H7	-
BB_, BB_A, BBS_, BBS_A	g6	h6	H7	J7
BBER_, BBER_A, BBERS_, BBERS_A	h6	j6		
BBER_L, BBER_LA, BBERS_L, BBERS_LA, BBERM_, BBERM_A, BBERMS_, BBERMS_A	h6	-	-	-
BBET_, BBEW_	h6	-	H7	-
KH_	h6	-	H7	-

Unsupported shafts can bend when they are long or subjected to external loads. To ensure reliable operation and a long service lifetime, the use of self-aligning super ball bushings (type BBET) is recommended. These are able to compensate for angular misalignments of up to ±0.5°.

3.3 Assembly instructions

Ball bushings must only be used for linear movements. They are not suitable for rotations on shafts (Figure 3.1). Rotations destroy ball bushings in a very short time.

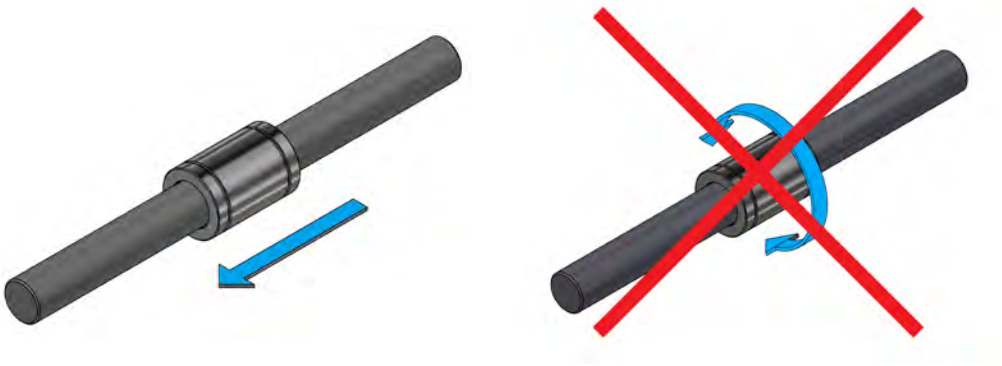


Figure 3.1 — Movement of Ball Bushings

3.3.1 Assembly ball bushings on shafts

- Only assemble ball bushings on deburred shafts.
- Carefully slide the ball bushings onto the shaft without tilting them.
- Align several shafts so that no parallelism errors occur. The values for the permissible parallelism errors are summarized in Table 3.2.

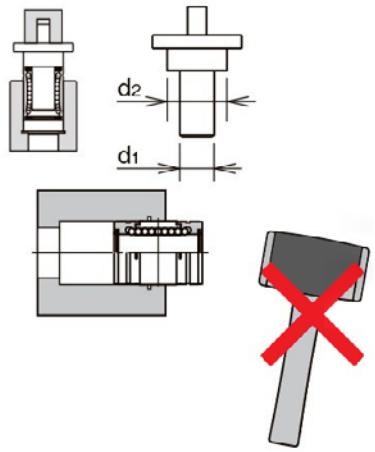
Table 3.2 — Permissible parallelism errors for ball bushings and linear units

Shaft diameter	Clearance fit			Transition fit	
	Type BBE_, BB_	Type KH_	Type LSE_, LSET_	Type BBE_, BB_	Type LSE_, LSET_
[mm]	[µm]	[µm]	[µm]	[µm]	[µm]
3	9			3	
4	10			3	
5	11			4	
6	12			4	
8	12		12	4	4
10	12		12	4	4
12	13	15	13	5	5
13	13			5	
14		16			
16	14	17	14	6	6
20	15	20	15	7	7
25	16	22	16	8	8
30	17	24	17	9	9
35	18			10	
40	19	25	19	11	11
50	21	28		13	
60	24			16	
80	30			22	
100	38			30	
120	50			38	
150	65			48	

3.3.2 Assembly of ball bushings in housing

Cylindrical ball bushings

- Insert the ball bushing carefully into the housing using an auxiliary tool.
- Only use suitable tools (Figure 3.2)



$d_1 = d - (0{,}3 \ldots 1{,}0\text{mm})$
$d_2 = D - (0{,}3 \ldots 1{,}0\text{mm})$

d	Inner diameter
D	Outer diameter

Figure 3.2 — Assembly of cylindrical ball bushings

Flange type ball bushings

- Insert the ball bushing carefully into the housing
- Fasten the ball bushing only with reference surface to the housing (Figure 3.3)

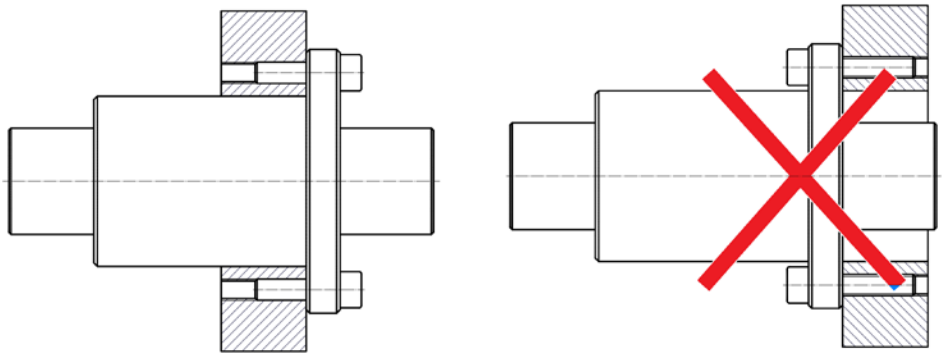


Figure 3.3 — Assembly of flange type ball bushings

4 Maintenance and lubrication

4.1 General information

Attention!
All maintenance and service work on the ball bushings must be carried out when the application is switched off and secured.

4.2 Lubrication

An adequate lubrication is essential for the reliable function of ball bushings.
The lubrication should ensure a lubricating film (oil film) between the rolling elements and the raceways of the guiding and drive elements to prevent wear and premature fatigue of the components.
In addition, the metallic surfaces are protected from corrosion. Furthermore, the lubricating film enables the seals to slide smoothly over the surfaces and reduces their wear.
Insufficient lubrication not only increases wear; it also significantly shortens the service lifetime.
An optimal selection of the lubricant has a decisive influence on the function and service life of the ball bushings. So that the function is not impaired and is maintained over a long period of time, lubrication must be defined according to the environmental conditions and the specific requirements.

Such environmental conditions and influencing factors can e.g. be:

- High or low temperature
- Effects of condensation and water splash
- Radiation exposure
- Strong vibrations
- Use in vacuum and / or clean rooms
- Application of special media (e.g. vapors, acids, etc.)
- High acceleration and velocity
- Permanent short stroke movement (< 2 x ball bushing length)
- Effect of dirt or dust

The recommendations in the following chapters enable the selection of the suitable lubricant, the required amount of lubricant and the definition of the lubrication interval.

These recommendations do not release the user from checking the specified lubrication intervals under the specific operating conditions in the application and adjusting them if necessary.

4.3 Lubricants

Different lubricants are suitable for the lubrication of ball bushings.

The lubricants must fulfill the following tasks:

- Reduction of friction
- Reduction of the starting torque
- Protection against premature wear
- Protection against corrosion
- Noise reduction

For use under normal conditions, lithium soap greases with the classification KP2-K according to DIN 51825 and NLGI class 2 according to DIN 51818 with EP additives must be used. SNR LUB HEAVY DUTY is used as the standard grease.

Attention!
Lubricants with solid additives (e.g. graphite or MoS_2) are not suitable.

Specific requirements under special environmental conditions require the selection of suitable lubricants. Basically, the compatibility of the lubricants with one another or with the anti-corrosion oil must be checked.

4.3.1 Anti-corrosion oils

Anti-corrosion oils serve to protect the ball bushings against corrosion during storage and transport. They are not suitable for lubrication of the ball bushings during operation.
During start-up and re-lubrication, compatibility with the existing lubricant must always be checked.
SNR ball bushings are supplied with anti-corrosion oil, which is compatible with the standard lubricant SNR LUB HEAVY DUTY. Preservation may be omitted by agreement for special applications with special lubricants.

4.3.2 Lubrication greases

Ball bushings with grease lubrication are used in most of the applications.

For use under normal conditions, lithium soap greases with the classification KP2-K according to DIN 51825 and NLGI class 2 according to DIN 51818 with EP additives must be used. SNR LUB HEAVY DUTY is used as the standard grease.

Specific requirements under special environmental conditions require the selection of suitable lubricants. Basically, the compatibility of the lubricants with one another or with the anti-corrosion oil must be checked.

Suitable lubrication greases for use in SNR ball bushings are summarized in Table 4.1.

Table 4.1 — Lubrication greases for ball bushings

Description	Base oil / Type of soap	NLGI class DIN51818	Walk- penetration DIN ISO 2137 at 25°C [0,1mm]	Basic oil viscosity DIN 51562 at 40°C [mm²/s]	Density [mg/cm³]	Properties	Application area
SNR LUB HEAVY DUTY	Mineral oil / Lithiumsoap with EP additives	2	295	app. 115	890	• very high protection against wear and corrosion	• General engineering • High loads
SNR LUB HIGH TEMP	semi-synthetic oil / Polyurea	2	265…295	160	900	• High temperature resistance • Good corrosion protection • High oxidation resistance	• High temperature range
SNR LUB FOOD AL	Paraffinic mineral oil, PAO / Aluminum complex soap	2	265…295	195	920	• Good corrosion protection • Very good adhesion properties • High water resistance • NSF H1 registered*	• Food industry
Microlube GL261	Mineral oil / special Lithium soap	1	310…340	280	890	• Good wearing protection • Particularly pressure resistant Additives against tribocorrosion	• General engineering • High loads • Short stroke application • Vibrations
Klübersynth BEM34-32	Synthetic hydrocarbon oil / special calcium soap	2	265...295	app. 30	890	• Particularly pressure resistant • Good wearing protection • Good ageing resistance • Low starting torque	• Clean room application
Klübersynth UH1 14-151	Synthetic hydrocarbon oil / ester oil Aluminum complex soap	1	310...340	app. 150	920	• Good corrosion protection • Good ageing resistance • High water resistance • NSF H1 registered*	• Food industry • Pharmaceutical industry

* This lubricant has been registered as an H1 product, i.e. it was developed for occasional, technically unavoidable contact with food. Experience has shown that the lubricant can also be used for appropriate applications in the pharmaceutical and cosmetic industry when the conditions in the product information are adhered to. However, no specific test results that might be required for applications in the pharmaceutical industry, e.g. biocompatibility, are available. The systems manufacturer and operator should therefore perform appropriate risk analyses before applications in this area. Measures to exclude health risks and injuries have to be taken, where required.
(Source: Klüber Lubrication)

4.4 Lubrication methods

SNR ball bushings with seals do not have a lubrication hole in the outer cylinder in the standard version. The lubricant can only be applied manually when the part is disassembled.

For ball bushings without seals, the lubricant can be applied to the shaft. Here, care must be taken to ensure that the lubricant is distributed evenly over the shaft diameter to reach all ball raceways.

For SNR ball bushings, a special design with a lubrication hole in the outer cylinder is available. These versions can be lubricated using a hand grease gun.

For further information, please contact our NTN application engineers.

4.5 Lubrication amounts

The respective minimum lubricant amount for ball bushings depends on the type of lubricant, diameter, design length and number of ball circuits.

When maintaining ball bushings, a distinction is made between:

- Initial lubrication
- Re-lubrication during operation

SNR ball bushings are preserved upon delivery and do not contain any initial lubrication. We recommend lubricating the ball bushings with the amount of lubricant required for initial lubrication before start-up.

Tables 4.2 to 4.15 contain the minimum lubricant amount for initial lubrication and the lubricant amounts with which SNR ball bushings, NTN ball sleeves and SNR linear units must be re-lubricated during operation.

Different lubricant amounts can be specified depending on the operating conditions.

For further information, please contact our NTN application engineers.

Table 4.2 — Lubricant amount for SNR ball bushings type BBE, BB, BBE_-AJ and BBER

Type				Initial greasing	Re-greasing
				[cm³]	[cm³]
BBE_3	BB_3			0,01	0,01
BBE_4	BB_4			0,02	0,01
BBE_5	BB_5	BBE_5_-AJ	BBER_5	0,02	0,01
	BB_6			0,02	0,01
	BB_8s			0,04	0,02
BBE_8	BB_8	BBE_8_-AJ	BBER_8	0,04	0,02
BBE_10	BB_10	BBE_10_-AJ	BBER_10	0,06	0,03
BBE_12	BB_12	BBE_12_-AJ	BBER_12	0,12	0,06
	BB_13			0,14	0,07
BBE_16	BB_16	BBE_16_-AJ	BBER_16	0,18	0,09
BBE_20	BB_20	BBE_20_-AJ	BBER_20	0,40	0,20
BBE_25	BB_25	BBE_25_-AJ	BBER_25	1,00	0,50
BBE_30	BB_30	BBE_30_-AJ	BBER_30	1,40	0,70
	BB_35			1,80	0,90
BBE_40	BB_40	BBE_40_-AJ	BBER_40	3,00	1,50
BBE_50	BB_50	BBE_50_-AJ	BBER_50	4,80	2,40
BBE_60	BB_60	BBE_60_-AJ	BBER_60	8,00	4,00
BBE_80	BB_80	BBE_80_-AJ	BBER_80	14,00	7,00
	BB_100			20,00	10,00
	BB_120			38,00	19,00
	BB_150			58,00	29,00

Table 4.3 — Lubricant amount for SNR ball bushings type BBE_L, BBER_L and BBERM

Type			Initial greasing	Re-greasing
			[cm³]	[cm³]
BBE_8_L	BBER_8_L	BBERM_8	0,07	0,04
BBE_10_L	BBER_10_L	BBERM_10	0,11	0,06
BBE_12_L	BBER_12_L	BBERM_12	0,22	0,11
BBE_16_L	BBER_16_L	BBERM_16	0,32	0,16
BBE_20_L	BBER_20_L	BBERM_20	0,72	0,36
BBE_25_L	BBER_25_L	BBERM_25	1,80	0,90
BBE_30_L	BBER_30_L	BBERM_30	2,50	1,25
BBE_40_L	BBER_40_L	BBERM_40	5,40	2,70
BBE_50_L	BBER_50_L	BBERM_50	8,60	4,30
BBE_60_L	BBER_60_L	BBERM_60	14,40	7,20

Table 4.4 — Lubricant amount for SNR ball bushings type BBE_-OP

Type	Initial greasing	Re-greasing
	[cm³]	[cm³]
BBE_10_-OP	0,04	0,02
BBE_12_-OP	0,06	0,03
BBE_16_-OP	0,08	0,04
BBE_20_-OP	0,40	0,20
BBE_25_-OP	0,70	0,35
BBE_30_-OP	1,50	0,75
BBE_40_-OP	2,40	1,20
BBE_50_-OP	3,80	1,90
BBE_60_-OP	6,80	3,40
BBE_80_-OP	12,00	6,00

Table 4.5 — Lubricant amount for NTN ball sleeves type KH

Type	Initial greasing	Re-greasing
	[cm³]	[cm³]
KH1228	0,08	0,04
KH1428	0,10	0,05
KH1630	0,12	0,06
KH2030	0,40	0,20
KH2540	0,60	0,30
KH3050	1,60	0,80
KH4060	2,80	1,40
KH5070	4,70	2,35

Table 4.6 — Lubricant amount for SNR ball bushings type BBET and BBEW

Type		Initial greasing	Re-greasing
		[cm³]	[cm³]
BBET8UU	BBEW8UU	0,04	0,02
BBET10UU	BBEW10UU	0,08	0,04
BBET12UU	BBEW12UU	0,20	0,10
BBET16UU	BBEW16UU	0,30	0,15
BBET20UU	BBEW20UU	0,80	0,40
BBET25UU	BBEW25UU	1,32	0,66
BBET30UU	BBEW30UU	1,70	0,85
BBET40UU	BBEW40UU	3,40	1,70
BBET50UU	BBEW50UU	5,40	2,70

Table 4.7 — Lubricant amount for SNR ball bushings type BBET_-OP and BBEW_-OP

Type		Initial greasing	Re-greasing
		[cm³]	[cm³]
BBET12UU-OP	BBEW12UU-OP	0,08	0,04
BBET16UU-OP	BBEW16UU-OP	0,12	0,06
BBET20UU-OP	BBEW20UU-OP	0,50	0,25
BBET25UU-OP	BBEW25UU-OP	0,70	0,35
BBET30UU-OP	BBEW30UU-OP	1,60	0,80
BBET40UU-OP	BBEW40UU-OP	2,40	1,20
BBET50UU-OP	BBEW50UU-OP	3,80	1,90

Table 4.8 — Lubricant amount for SNR linear units type LSE and LSE_-AJ

Type		Initial greasing	Re-greasing
		[cm³]	[cm³]
LSE12	LSE12_-AJ	0,12	0,06
LSE16	LSE16_-AJ	0,18	0,09
LSE20	LSE20_-AJ	0,40	0,20
LSE25	LSE25_-AJ	1,00	0,50
LSE30	LSE30_-AJ	1,40	0,70
LSE40	LSE40_-AJ	3,00	1,50

Table 4.9 — Lubricant amount for SNR linear units type LSE_L, LSE_L_-AJ and LSE_Q

Type			Initial greasing	Re-greasing
			[cm³]	[cm³]
LSE12L	LSE12L_-AJ	LSE12Q*	0,24	0,12
LSE16L	LSE16L_-AJ	LSE16Q*	0,36	0,18
LSE20L	LSE20L_-AJ	LSE20Q*	0,80	0,40
LSE25L	LSE25L_-AJ	LSE25Q*	2,00	1,00
LSE30L	LSE30L_-AJ	LSE30Q*	2,80	1,40
LSE40L	LSE40L_-AJ	LSE40Q*	6,00	3,00

* Apply the specified amount of grease to both sides

Table 4.10 — Lubricant amount for SNR linear units type LSE_-OP, LSE_-AO, LSE_-SOP and LSE_-SAO

Type				Initial greasing	Re-greasing
				[cm³]	[cm³]
LSE12_-OP	LSE12_-AO			0,06	0,03
LSE16_-OP	LSE16_-AO			0,08	0,04
LSE20_-OP	LSE20_-AO	LSE20_-SOP	LSE20_-SAO	0,40	0,20
LSE25_-OP	LSE25_-AO	LSE25_-SOP	LSE25_-SAO	0,70	0,35
LSE30_-OP	LSE30_-AO	LSE30_-SOP	LSE30_-SAO	1,50	0,75
LSE40_-OP	LSE40_-AO	LSE40_-SOP	LSE40_-SAO	2,40	1,20

Table 4.11 — Lubricant amount for SNR linear units type LSE_L_-OP, LSE_L_-AO and LSE_Q_-OP

Type			Initial greasing	Re-greasing
			[cm³]	[cm³]
LSE12L_-OP	LSE12L_-AO	LSE12Q_-OP*	0,12	0,06
LSE16L_-OP	LSE16L_-AO	LSE16Q_-OP*	0,16	0,08
LSE20L_-OP	LSE20L_-AO	LSE20Q_-OP*	0,80	0,40
LSE25L_-OP	LSE25L_-AO	LSE25Q_-OP*	1,40	0,70
LSE30L_-OP	LSE30L_-AO	LSE30Q_-OP*	3,00	1,50
LSE40L_-OP	LSE40L_-AO	LSE40Q_-OP*	4,80	2,40

* Apply the specified amount of grease to both sides

Table 4.12 — Lubricant amount for SNR linear units type LSET

Type	Initial greasing	Re-greasing
	[cm³]	[cm³]
LSET8	0,04	0,02
LSET10	0,08	0,04
LSET12	0,20	0,10
LSET16	0,30	0,15
LSET20	0,80	0,40
LSET25	1,32	0,66
LSET30	1,70	0,85
LSET40	3,40	1,70

Table 4.13 — Lubricant amount for SNR linear units type LSET_L

Type	Initial greasing	Re-greasing
	[cm³]	[cm³]
LSET8L	0,08	0,04
LSET10L	0,16	0,08
LSET12L	0,40	0,20
LSET16L	0,60	0,30
LSET20L	1,60	0,80
LSET25L	2,64	1,32
LSET30L	3,40	1,70
LSET40L	6,80	3,40

Table 4.14 — Lubricant amount for SNR linear units type LSET_-OP and LSE_-AO

Type		Initial greasing	Re-greasing
		[cm³]	[cm³]
LSET12_-OP	LSET12_-AO	0,08	0,04
LSET16_-OP	LSET16_-AO	0,12	0,06
LSET20_-OP	LSET20_-AO	0,50	0,25
LSET25_-OP	LSET25_-AO	0,70	0,35
LSET30_-OP	LSET30_-AO	1,60	0,80
LSET40_-OP	LSET40_-AO	2,40	1,20

Table 4.15 — Lubricant amount for SNR linear units type LSET_L_-OP and LSE_L_-AO

Type		Initial greasing	Re-greasing
		[cm³]	[cm³]
LSET12L_-OP	LSET12L_-AO	0,16	0,08
LSET16L_-OP	LSET16L_-AO	0,24	0,12
LSET20L_-OP	LSET20L_-AO	1,00	0,50
LSET25L_-OP	LSET25L_-AO	1,40	0,70
LSET30L_-OP	LSET30L_-AO	3,20	1,60
LSET40L_-OP	LSET40L_-AO	4,80	2,40

4.6 Lubrication intervals

The re-lubrication intervals are influenced by many factors (Chapter 4.2). The load and the existing contamination usually have the greatest influence. Other influence factors are:

- Velocity
- Viscosity of the lubricant
- Short stroke application
- …

Exact relubrication intervals can only be determined after assessment under real operating conditions and evaluation over a sufficiently long period of time for a specific application.

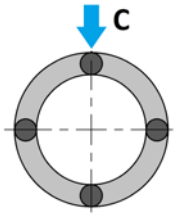
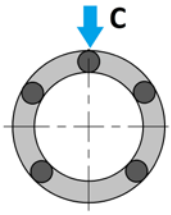
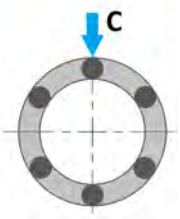
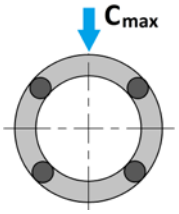
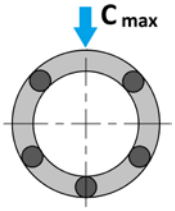
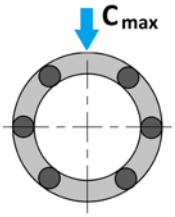
5 SNR ball bushings and SNR linear units

Correction of load ratings

For closed and adjustable ball bushings, the load ratings differ between directional and non-directional assembly. The load ratings C and C0 in the data tables contain the load ratings for non-directional assembly, which are considered the most unfavorable position of the ball rows in relation to the load direction. In this case, only one ball row is loaded.

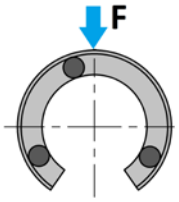
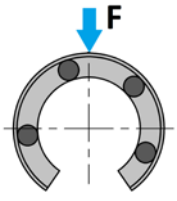
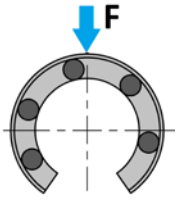
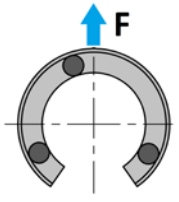
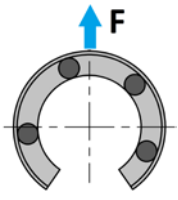
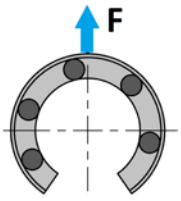
Ball bushings achieve their maximum load ratings with directional assembly. In this case, the load ratings increase to the values C_{max} and $C0_{max}$, which are also specified in the data tables. The position of the rows for directional and non-directional installation is shown in Table 5.1 depending on the number of ball rows.

Table 5.1 — Position of the ball rows when installing closed and adjustable ball bushings

	Nunber of ball rows		
	4 and 8	5	6
non-directional installation			
directional installation			

For open ball bushings, load ratings for radial and reverse-radial loads are specified in the data tables. The factor by which the load ratings must be reduced in the reverse-radial direction depends on the number of ball rows. The load position is shown in Table 5.2.

Table 5.2 — Load direction for open ball bushings

	Nunber of ball rows		
	3	4	5
Radial load			
Reverse radial load			

Sealing options

SNR ball bushings have lip seals on both sides as standard. Versions without seals are available on request. For further information, please contact our NTN application engineers.

Materials

The steel parts and cage of SNR standard ball bushings are available in various material combinations, which are summarized in Table 5.3 Depending on the material combination, the ball bushings can be used for different temperature ranges.

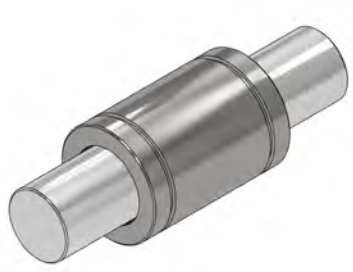
Table 5.3 — Material combinations for SNR ball bushings

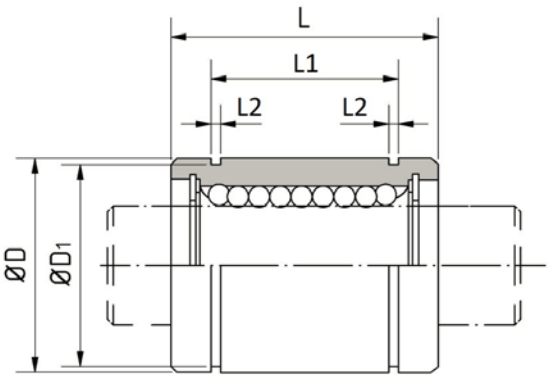
Designation	Material					Temperature range
	Outer cylinder	Raceway bar	Cage	Balls	Seals	
BBE_UU	Roller bearing steel 100Cr6	-	Plastic PA	Roller bearing steel 100Cr6	Nitrile rubber NBR	-20°C...80°C
BB_UU						
BBER_UU						
BBERM_UU						
BBE_A AUU	Roller bearing steel 100Cr6	-	unalloyed steel St15 or RSt34-2	Roller bearing steel 100Cr6	Nitrile rubber NBR	-20°C...110°C
BB_AUU						
BBER_AUU						
BBERM_AUU						
BBES_UU	martensitic stainless steel 105CrMo17	-	Plastic PA	Roller bearing steel 100Cr6	Nitrile rubber NBR	-20°C...80°C
BBS_UU						
BBERS_UU						
BBERMS_UU						
BBES_AUU	martensitic stainless steel 105CrMo17	-	martensitic stainless steel 105CrMo17	Roller bearing steel 100Cr6	Nitrile rubber NBR	-20°C...140°C*
BBS_AUU						
BBERS_AUU						
BBERMS_AUU						
BBET_UU	Plastic PA	Roller bearing steel 100Cr6	Plastic PA	Roller bearing steel 100Cr6	Nitrile rubber NBR	-20°C...80°C
BBEW_UU						
KH_LL/3AS	Roller bearing steel 100Cr6	-	Plastic PA	Roller bearing steel 100Cr6	Nitrile rubber NBR	-20°C...80°C

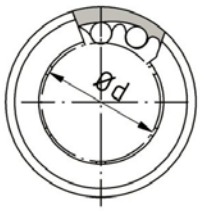
* Maximum temperature for ball bushings with seals 120°C

5.1 SNR-Standard ball bushings

5.1.1 Standard ball bushings BBE_UU, BBE_AUU, BBES_UU, BBES_AUU, closed, ISO dimension

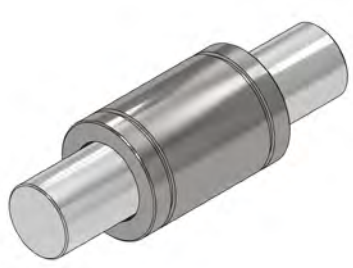


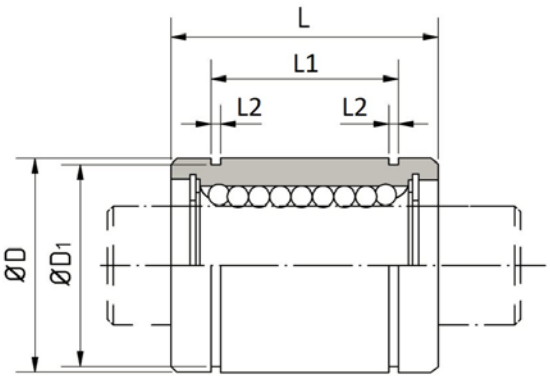


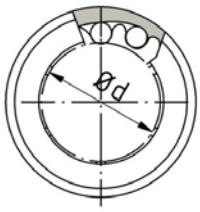


Standard		Stainless		d	Tolerance	D	Tolerance	L	Tolerance	L1	Tolerance	L2	D1	Number of ball rows	Max. eccentricity	Max. radial clearance	Dynamic load rating C	Static load rating C0	Dynamic load rating C_{max}	Static load rating $C0_{max}$	Weight
Plastic cage	Steel cage	Plastic cage	Stainless steel cage	[mm]	[µm]	[mm]	[µm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]		[µm]	[µm]	[N]	[N]	[N]	[N]	[g]
BBE3UU	BBE3AUU	BBES3UU	BBES3AUU	3	+8 0	7	0 -8	10	0 -0,12	–	–	-	-	4	10	-3	44	105	62	148	1,4
BBE4UU	BBE4AUU	BBES4UU	BBES4AUU	4		8		12		–		-	-	4			55	127	78	180	2
BBE5UU	BBE5AUU	BBES5UU	BBES5AUU	5		12		22	0 -0,2	14,5	0 -0,2	1,10	11,5	4	12		159	265	225	375	11
BBE8UU	BBE8AUU	BBES8UU	BBES8AUU	8		16		25		16,5		1,10	15,2	4			195	402	276	568	22
BBE10UU	BBE10AUU	BBES10UU	BBES10AUU	10		19	0 -9	29		22,0		1,30	18,0	4		-4	286	549	404	776	36
BBE12UU	BBE12AUU	BBES12UU	BBES12AUU	12		22		32		22,9		1,30	21,0	4			419	784	592	1 109	45
BBE16UU	BBE16AUU	BBES16UU	BBES16AUU	16	+9 -1	26		36		24,9		1,30	24,9	4			432	892	611	1 261	60
BBE20UU	BBE20AUU	BBES20UU	BBES20AUU	20		32		45		31,5		1,60	30,3	5	15	-6	877	1 370	1 283	2 004	102
BBE25UU	BBE25AUU	BBES25UU	BBES25AUU	25	+11 -1	40	0 -11	58	0 -0,3	44,1	0 -0,3	1,85	37,5	6			908	1 570	1 162	2 242	235
BBE30UU	BBE30AUU	BBES30UU	BBES30AUU	30		47		68		52,1		1,85	44,5	6		-8	1 584	2 740	2 028	3 913	360
BBE40UU	BBE40AUU	BBES40UU	BBES40AUU	40	+13 -2	62	0 -13	80		60,6		2,15	59,0	6	17		2 357	4 020	3 017	5 741	770
BBE50UU	BBE50AUU	BBES50UU	BBES50AUU	50		75		100		77,6		2,65	72,0	6		-13	4 702	7 940	6 019	11 338	1 250
BBE60UU	BBE60AUU	BBES60UU	BBES60AUU	60		90	0 -15	125	0 -0,4	101,7	0 -0,4	3,15	86,5	6	20		6 085	9 800	7 789	13 994	2 220
–	BBE80AUU	–	–	80	+16 -4	120		165		133,7		4,15	116,0	6		-20	9 456	16 000	12 104	22 848	5 140

5.1.2 Standard ball bushings BB_UU, BB_AUU, BBS_UU, BBS_AUU, closed, JIS dimension

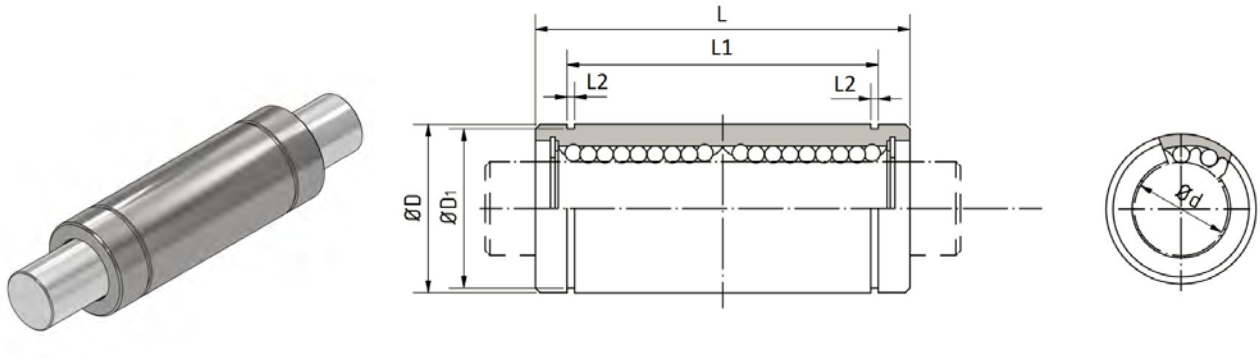






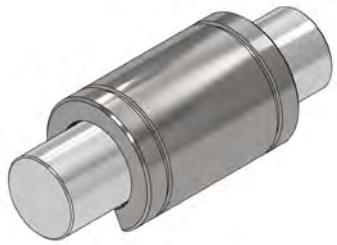
Standard		Stainless		d	Tolerance	D	Tolerance	L	Tolerance	L1	Tolerance	L2	D1	Number of ball rows	Max. eccentricity	Max. radial clearance	Dynamic load rating C	Static load rating C0	Dynamic load rating Cmax	Static load rating C0max	Weight
Plastic cage	Steel cage	Plastic cage	Stainless steel cage	[mm]	[µm]	[mm]	[µm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]		[µm]	[µm]	[N]	[N]	[N]	[N]	[g]
BB3UU	BB3AUU	BBS3UU	BBS3AUU	3	0 -8	7	0 -9	10	0 -0,12	–	–	-	-	4	8	-3	44	105	62	148	1
BB4UU	BB4AUU	BBS4UU	BBS4AUU	4		8		12		–		-	-	4			47	127	66	180	2
BB5UU	BB5AUU	BBS5UU	BBS5AUU	5		10		15		10,2	0 -0,2	1,10	9,6	4			82	206	116	291	4
BB6UU	BB6AUU	BBS6UU	BBS6AUU	6	0 -9	12	0 -11	19	0 -0,2	13,5		1,10	11,5	4	12		131	265	185	375	9
BB8sUU	BB8sAUU	BBS8sUU	BBS8sAUU	8		15		17		11,5		1,10	14,3	4			153	216	216	305	11
BB8UU	BB8AUU	BBS8UU	BBS8AUU	8		15		24		17,5		1,10	14,3	4			194	392	274	554	17
BB10UU	BB10AUU	BBS10UU	BBS10AUU	10		19	0 -13	29		22,0		1,30	18,0	4		-4	286	594	404	840	36
BB12UU	BB12AUU	BBS12UU	BBS12AUU	12		21		30		23,0		1,30	20,0	4			415	784	587	1 109	42
BB13UU	BB13AUU	BBS13UU	BBS13AUU	13		23		32		23,0		1,30	22,0	4			421	784	595	1 109	49
BB16UU	BB16AUU	BBS16UU	BBS16AUU	16		28		37		26,5		1,60	27,0	4		-6	676	1 180	956	1 669	76
BB20UU	BB20AUU	BBS20UU	BBS20AUU	20	0 -10	32	0 -16	42		30,5		1,60	30,5	5	15		792	1 370	1 159	2 004	100
BB25UU	BB25AUU	BBS25UU	BBS25AUU	25		40		59	0 -0,3	41,0	0 -0,3	1,85	38,0	6			1 073	1 570	1 373	2 242	240
BB30UU	BB30AUU	BBS30UU	BBS30AUU	30		45		64		44,5		1,85	43,0	6		-8	1 584	2 740	2 028	3 913	270
BB35UU	BB35AUU	BBS35UU	BBS35AUU	35	0 -12	52	0 -19	70		49,5		2,10	49,0	6	20		1 875	3 140	2 400	4 484	425
BB40UU	BB40AUU	BBS40UU	BBS40AUU	40		60		80		60,5		2,10	57,0	6		-10	2 357	4 020	3 017	5 741	654
BB50UU	BB50AUU	BBS50UU	BBS50AUU	50		80		100		74,0		2,60	76,5	6		-13	4 702	7 940	6 019	11 338	1 700
BB60UU	BB60AUU	BBS60UU	BBS60AUU	60	0 -15	90	0 -22	110		85,0		3,15	86,5	6	25		5 606	10 000	7 176	14 280	2 000
BB80UU	BB80AUU	BBS80UU	BBS80AUU	80		120		140	0 -0,4	105,5	0 -0,4	4,15	116,0	6		-20	10 347	16 000	13 244	22 848	4 520
–	BB100AUU	–	–	100	0 -20	150	0 -25	175		125,5		4,15	145,0	6	30		17 323	34 800	22 173	49 694	8 600
–	BB120AUU	–	–	120		180		200		158,6		4,15	175,0	8		-25	24 571	40 000	34 743	56 560	15 000
–	BB150AUU	–	–	150	0 -25	210	0 -29	240		170,6		5,15	204,0	8	40		33 701	54 300	47 653	76 780	20 250

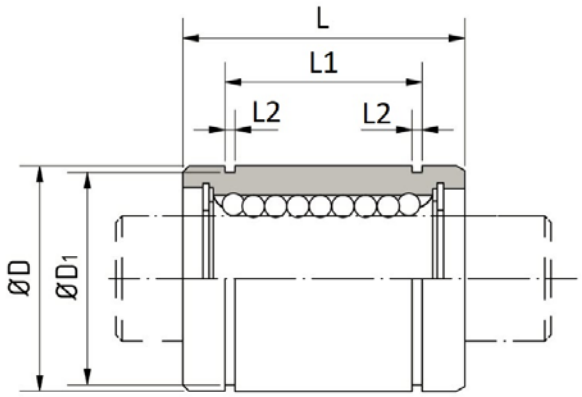
5.1.3 Tandem ball bushings BBE_LUU, BBE_LAUU, BBES_LUU, BBES_LAUU, closed, ISO dimension

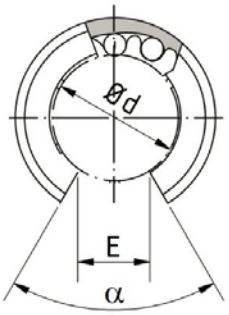


Standard		Stainless		d	Tolerance	D	Tolerance	L	Tolerance	L1	Tolerance	L2	D1	Number of ball rows	Max. eccentricity	Dynamic load rating C	Static load rating C0	Dynamic load rating C_{max}	Static load rating $C0_{max}$	Weight
Plastic cage	Steel cage	Plastic cage	Stainless steel cage	[mm]	[µm]	[mm]	[µm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]		[µm]	[N]	[N]	[N]	[N]	[g]
BBE8LUU	BBE8LAUU	BBES8LUU	BBES8LAUU	8	+9 0	16	0 -9	46	0 -0,3	33,0	0 -0,3	1,10	15,2	4	15	320	804	452	1 137	40
BBE12LUU	BBE12LAUU	BBES12LUU	BBES12LAUU	12		22	0 -11	61		45,8		1,30	21,0	4		683	1 570	966	2 220	80
BBE16LUU	BBE16LAUU	BBES16LUU	BBES16LAUU	16	+11 -1	26		68		49,8		1,30	24,9	4		710	1 780	1 004	2 517	115
BBE20LUU	BBE20LAUU	BBES20LUU	BBES20LAUU	20		32	0 -13	80		61,0		1,60	30,3	5	17	1 440	2 740	2 107	4 009	180
BBE25LUU	BBE25LAUU	BBES25LUU	BBES25LAUU	25	+13 -2	40		112	0 -0,4	82,0	0 -0,4	1,85	37,5	6		1 490	3 140	1 907	4 484	430
BBE30LUU	BBE30LAUU	BBES30LUU	BBES30LAUU	30		47		123		104,2		1,85	44,5	6		2 600	5 490	3 328	7 840	615
BBE40LUU	BBE40LAUU	BBES40LUU	BBES40LAUU	40	+16 -4	62	0 -15	151		121,2		2,15	59,0	6	20	3 872	8 040	4 956	11 481	1 400
BBE50LUU	BBE50LAUU	BBES50LUU	BBES50LAUU	50		75		192		155,2		2,65	72,0	6		7 701	15 900	9 857	22 705	2 320
BBE60LUU	BBE60LAUU	BBES60LUU	BBES60LAUU	60		90	0 -20	209		170,0		3,15	86,5	6	25	9 940	20 000	12 723	28 560	3 920

5.1.4 Standard ball bushings BBE_UU-OP, BBE_AUU-OP, BBES_UU-OP, BBES_AUU-OP, open, ISO dimension

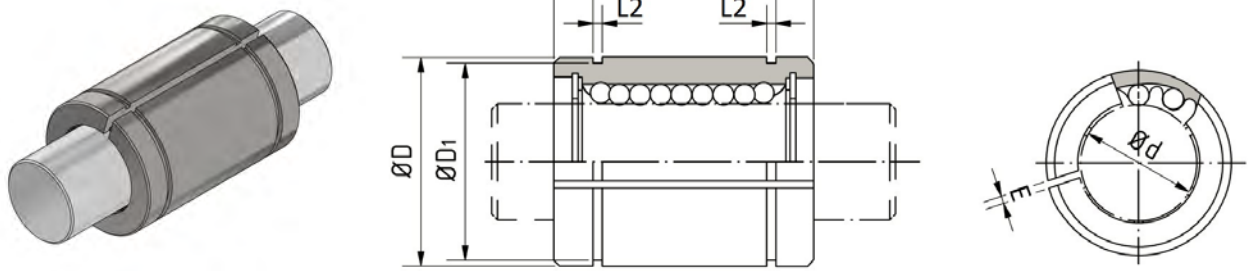






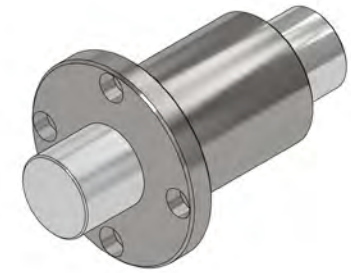
Standard		Stainless		d	Tolerance	D	Tolerance	L	Tolerance	L1	Tolerance	L2	D1	E	α	Number of ball rows	Max. eccentricity	Max. radial clearance	Radial dynamic load rating C	Radial static load rating C0	Reverse radial dynamic load rating C	Reverse radial static load rating C0	Weight
Plastic cage	Steel cage	Plastic cage	Stainless steel cage	[mm]	[µm]	[mm]	[µm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[°]		[µm]	[µm]	[N]	[N]	[N]	[N]	[g]
BBE10UU-OP	–	BBES10UU-OP	–	10	+8 0	19	0 -9	29		22,0	0 -0,2	1,30	18,0	6,8	80	3	12	-4	286	549	183	351	23
BBE12UU-OP	BBE12AUU-OP	BBES12UU-OP	BBES12AUU-OP	12		22		32		22,9		1,30	21,0	7,5	78	3			416	784	266	502	35
BBE16UU-OP	BBE16AUU-OP	BBES16UU-OP	BBES16AUU-OP	16	+9 -1	26		36		24,9		1,30	24,9	10,0	78	3			432	892	276	571	48
BBE20UU-OP	BBE20AUU-OP	BBES20UU-OP	BBES20AUU-OP	20		32	0 -11	45		31,5		1,60	30,3	10,0	60	4	15	-6	877	1 370	474	740	84
BBE25UU-OP	BBE25AUU-OP	BBES25UU-OP	BBES25AUU-OP	25	+11 -1	40		58	0 -0,3	44,1	0 -0,3	1,85	37,5	12,5	60	5			908	1 570	518	895	195
BBE30UU-OP	BBE30AUU-OP	BBES30UU-OP	BBES30AUU-OP	30		47		68		52,1		1,85	44,5	12,5	50	5		-8	1 584	2 740	903	1 562	309
BBE40UU-OP	BBE40AUU-OP	BBES40UU-OP	BBES40AUU-OP	40	+13 -2	62	0 -13	80		60,6		2,15	59,0	16,8	50	5	17		2 357	4 020	1 343	2 291	665
BBE50UU-OP	BBE50AUU-OP	BBES50UU-OP	BBES50AUU-OP	50		75		100		77,6		2,65	72,0	21,0	50	5		-13	4 702	7 940	2 680	4 526	1 080
BBE60UU-OP	BBE60AUU-OP	BBES60UU-OP	BBES60AUU-OP	60		90	0 -15	125	0 -0,4	101,7	0 -0,4	3,15	86,5	27,2	54	5	20		6 085	9 800	3 468	5 586	1 900
–	BBE80AUU-OP	–	–	80	+16 -4	120		165		133,7		4,15	116,0	36,3	54	5		-20	9 456	16 000	5 390	9 120	4 380

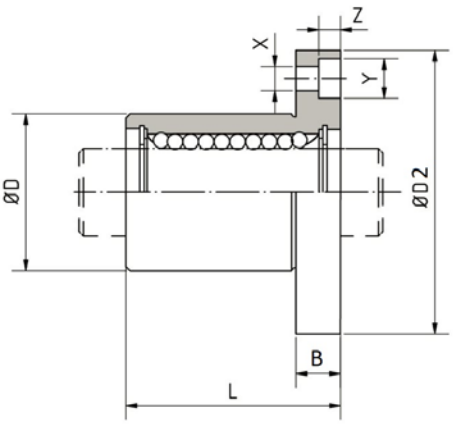
5.1.5 Standard ball bushings BBE_UU-AJ, BBE_AUU-AJ, BBES_UU-AJ, BBES_AUU-AJ, adjustable, ISO dimension

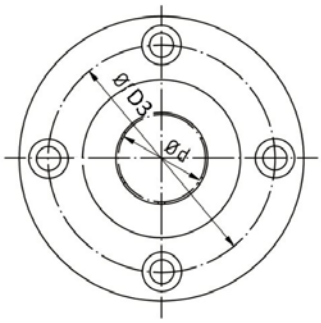


Standard		Stainless		d	Tolerance	D	Tolerance	L	Tolerance	L1	Tolerance	L2	D1	E	Number of ball rows	Max. eccentricity	Dynamic load rating C	Static load rating C0	Dynamic load rating C_{max}	Static load rating $C0_{max}$	Weight
Plastic cage	Steel cage	Plastic cage	Stainless steel cage	[mm]	[µm]	[mm]	[µm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]		[µm]	[N]	[N]	[N]	[N]	[g]
BBE5UU-AJ	–	BBES5UU-AJ	–	5	+8 0	12	0 -8	22	0 -0,2	14,5	0 -0,2	1,10	11,5	1,0	4	12	159	265	225	375	10
BBE8UU-AJ	–	BBES8UU-AJ	–	8		16		25		16,5		1,10	15,2	1,0	4		195	402	276	568	20
BBE10UU-AJ	–	BBES10UU-AJ	–	10		19	0 -9	29		22,0		1,30	18,0	1,0	4		286	549	404	776	29
BBE12UU-AJ	BBE12AUU-AJ	BBES12UU-AJ	BBES12AUU-AJ	12		22		32		22,9		1,30	21,0	1,5	4		419	784	592	1 109	44
BBE16UU-AJ	BBE16AUU-AJ	BBES16UU-AJ	BBES16AUU-AJ	16	+9 -1	26		36		24,9		1,30	24,9	1,5	4		432	892	611	1 261	59
BBE20UU-AJ	BBE20AUU-AJ	BBES20UU-AJ	BBES20AUU-AJ	20		32	0 -11	45		31,5		1,60	30,3	2,0	5	15	877	1 370	1 283	2 004	100
BBE25UU-AJ	BBE25AUU-AJ	BBES25UU-AJ	BBES25AUU-AJ	25	+11 -1	40		58	0 -0,3	44,1	0 -0,3	1,85	37,5	2,0	6		908	1 570	1 162	2 242	230
BBE30UU-AJ	BBE30AUU-AJ	BBES30UU-AJ	BBES30AUU-AJ	30		47		68		52,1		1,85	44,5	2,0	6		1 584	2 740	2 028	3 913	355
BBE40UU-AJ	BBE40AUU-AJ	BBES40UU-AJ	BBES40AUU-AJ	40	+13 -2	62	0 -13	80		60,6		2,15	59,0	3,0	6	17	2 357	4 020	3 017	5 741	758
BBE50UU-AJ	BBE50AUU-AJ	BBES50UU-AJ	BBES50AUU-AJ	50		75		100		77,6		2,65	72,0	3,0	6		4 702	7 940	6 019	11 338	1 230
BBE60UU-AJ	BBE60AUU-AJ	BBES60UU-AJ	BBES60AUU-AJ	60		90	0 -15	125	0 -0,4	101,7	0 -0,4	3,15	86,5	3,0	6	20	6 085	9 800	7 789	13 994	2 170
–	BBE80A	–	–	80	+16 -4	120		165		133,7		4,15	116,0	3,0	6		9 456	16 000	12 104	22 848	5 000

5.1.6 Standard flange type ball bushings BBER_UU, BBER_AUU, BBERS_UU, BBERS_AUU, ISO dimension

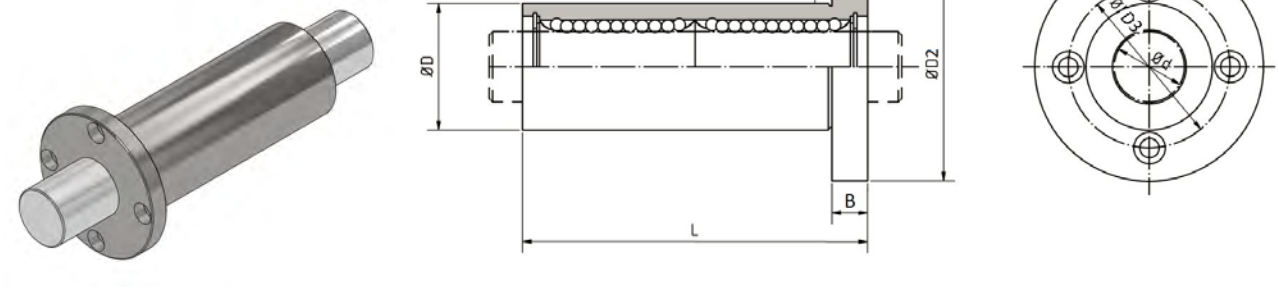






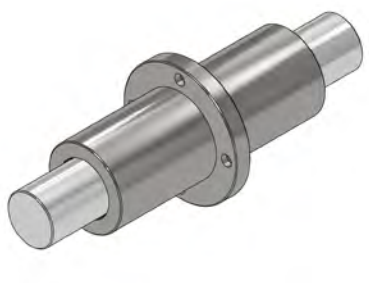
Standard		Stainless		d	Tolerance	D	Tolerance	L	Tolerance	D2	B	D3	X	Y	Z	Number of ball rows	Max. eccentricity	Max. angular deviation	Dynamic load rating C	Static load rating C0	Dynamic load rating C^{max}	Static load rating $C0^{max}$	Weight
Plastic cage	Steel cage	Plastic cage	Stainless steel cage	[mm]	[µm]	[mm]	[µm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]		[µm]	[µm]	[N]	[N]	[N]	[N]	[g]
BBER5UU	–	BBERS5UU	–	5	+8 0	12	0 -13	22	0 -0,2	28	5	20	3,5	6,0	3,1	4	12	12	159	265	225	375	26
BBER8UU	BBER8AUU	BBERS8UU	BBERS8AUU	8		16		25		32	5	24	3,5	6,0	3,1	4			195	402	276	568	41
BBER12UU	BBER12AUU	BBERS12UU	BBERS12AUU	12		22	0 -16	32		42	6	32	4,5	7,5	4,1	4			419	784	592	1 109	80
BBER16UU	BBER16AUU	BBERS16UU	BBERS16AUU	16	+9 -1	26		36		46	6	36	4,5	7,5	4,1	4			432	892	611	1 261	103
BBER20UU	BBER20AUU	BBERS20UU	BBERS20AUU	20		32	0 -19	45		54	8	43	5,5	9,0	5,1	5	15	15	877	1 370	1 283	2 004	182
BBER25UU	BBER25AUU	BBERS25UU	BBERS25AUU	25	+11 -1	40		58	0 -0,3	62	8	51	5,5	9,0	5,1	6			908	1 570	1 162	2 242	335
BBER30UU	BBER30AUU	BBERS30UU	BBERS30AUU	30		47		68		76	10	62	6,6	11,0	6,1	6			1 584	2 740	2 028	3 913	560
BBER40UU	BBER40AUU	BBERS40UU	BBERS40AUU	40	+13 -2	62	0 -22	80		98	13	80	9,0	14,0	8,1	6	17	17	2 357	4 020	3 017	5 741	1 175
BBER50UU	BBER50AUU	BBERS50UU	BBERS50AUU	50		75		100		112	13	94	9,0	14,0	8,1	6			4 702	7 940	6 019	11 338	1 745
BBER60UU	BBER60AUU	BBERS60UU	BBERS60AUU	60		90	0 -25	125	0 -0,4	134	18	112	11,0	17,0	11,1	6	20	20	6 085	9 800	7 789	13 994	3 220
–	BBER80AUU	–	–	80	+16 -4	120		165		164	18	142	11,0	17,0	11,1	6			9 456	16 000	12 104	22 848	6 420

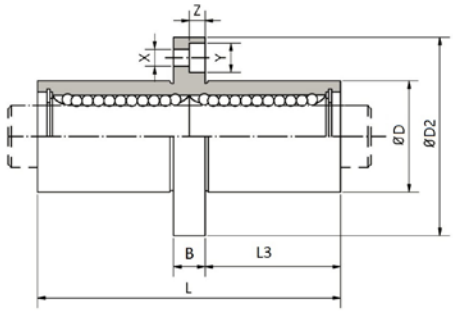
5.1.7 Tandem flange type ball bushings BBER_LUU, BBER_LAUU, BBERS_LUU, BBERS_LAUU, ISO dimension

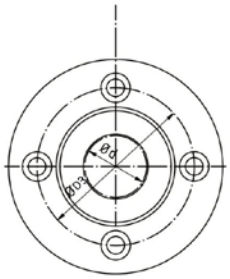


Standard		Stainless		d	Tolerance	D	Tolerance	L	Tolerance	D2	B	D3	X	Y	Z	Number of ball rows	Max. eccentricity	Max. angular deviation	Dynamic load rating C	Static load rating C0	Dynamic load rating C_{max}	Static load rating $C0_{max}$	Weight
Plastic cage	Steel cage	Plastic cage	Stainless steel cage	[mm]	[µm]	[mm]	[µm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]		[µm]	[µm]	[N]	[N]	[N]	[N]	[g]
BBER8LUU	BBER8LAUU	BBERS8LUU	BBERS8LAUU	8	+9 -1	16	0 -13	46	±0,3	32	5	24	3,5	6,0	3,1	4	15	15	320	804	452	1 137	59
BBER12LUU	BBER12LAUU	BBERS12LUU	BBERS12LAUU	12		22	0 -16	61		42	6	32	4,5	7,5	4,1	4			683	1 570	966	2 220	110
BBER16LUU	BBER16LAUU	BBERS16LUU	BBERS16LAUU	16	+11 -1	26		68		46	6	36	4,5	7,5	4,1	4			710	1 780	1 004	2 517	160
BBER20LUU	BBER20LAUU	BBERS20LUU	BBERS20LAUU	20		32	0 -19	80		54	8	43	5,5	9,0	5,1	5	17	17	1 440	2 740	2 107	4 009	260
BBER25LUU	BBER25LAUU	BBERS25LUU	BBERS25LAUU	25	+13 -2	40		112		62	8	51	5,5	9,0	5,1	6			1 490	3 140	1 907	4 484	540
BBER30LUU	BBER30LAUU	BBERS30LUU	BBERS30LAUU	30		47		123		76	10	62	6,6	11,0	6,1	6			2 600	5 490	3 328	7 840	815
BBER40LUU	BBER40LAUU	BBERS40LUU	BBERS40LAUU	40	+16 -4	62	0 -22	151		98	13	80	9,0	14,0	8,1	6	20	20	3 872	8 040	4 956	11 481	1 805
BBER50LUU	BBER50LAUU	BBERS50LUU	BBERS50LAUU	50		75		192		112	13	94	9,0	14,0	8,1	6			7 701	15 900	9 857	22 705	2 820
BBER60LUU	BBER60LAUU	BBERS60LUU	BBERS60LAUU	60		90	0 -25	209		134	18	112	11,0	17,0	11,1	6	25	25	9 940	20 000	12 723	28 560	4 920

5.1.8 Middle flange type ball bushings BBERM_UU, BBERM_AUU, BBERMS_UU, BBERMS_AUU, ISO dimension



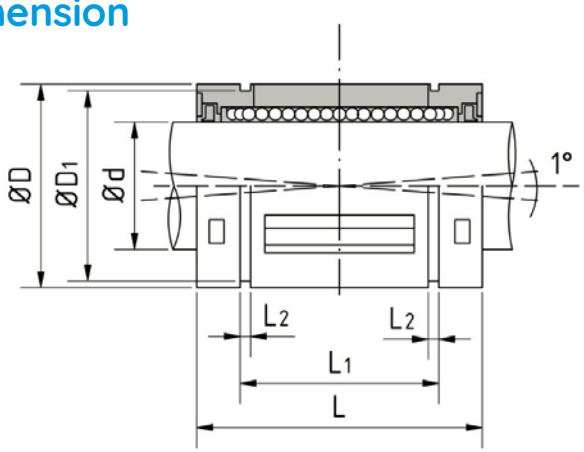


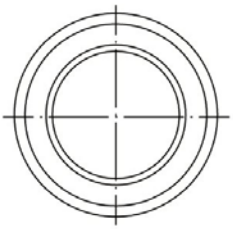


Standard		Stainless		d	Tolerance	D	Tolerance	L	Tolerance	L3	D2	B	D3	X	Y	Z	Number of ball rows	Max. eccentricity	Max. angular deviation	Dynamic load rating C	Static load rating C0	Dynamic load rating C_{max}	Static load rating $C0_{max}$	Weight
Plastic cage	Steel cage	Plastic cage	Stainless steel cage	[mm]	[µm]	[mm]	[µm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]		[µm]	[µm]	[N]	[N]	[N]	[N]	[g]
BBERM8UU	BBERM8AUU	BBERMS8UU	BBERMS8AUU	8	+9 -1	16	0 -13	46		20,5	32	5	24	3,5	6,0	3,1	4			320	804	452	1 137	59
BBERM12UU	BBERM12AUU	BBERMS12UU	BBERMS12AUU	12		22	0 -16	61		27,5	42	6	32	4,5	7,5	4,1	4	15	15	683	1 570	966	2 220	110
BBERM16UU	BBERM16AUU	BBERMS16UU	BBERMS16AUU	16	+11 -1	26		68		31,0	46	6	36	4,5	7,5	4,1	4			710	1 780	1 004	2 517	160
BBERM20UU	BBERM20AUU	BBERMS20UU	BBERMS20AUU	20		32	0 -19	80		36,0	54	8	43	5,5	9,0	5,1	5			1 440	2 740	2 107	4 009	260
BBERM25UU	BBERM25AUU	BBERMS25UU	BBERMS25AUU	25	+13 -2	40		112	±0,3	52,0	62	8	51	5,5	9,0	5,1	6	17	17	1 490	3 140	1 907	4 484	540
BBERM30UU	BBERM30AUU	BBERMS30UU	BBERMS30AUU	30		47		123		56,5	76	10	62	6,6	11,0	6,1	6			2 600	5 490	3 328	7 840	815
BBERM40UU	BBERM40AUU	BBERMS40UU	BBERMS40AUU	40	+16 -4	62	0 -22	151		69,0	98	13	80	9,0	14,0	8,1	6	20	20	3 872	8 040	4 956	11 481	1 805
BBERM50UU	BBERM50AUU	BBERMS50UU	BBERMS50AUU	50		75		192		89,5	112	13	94	9,0	14,0	8,1	6			7 701	15 900	9 857	22 705	2 820
BBERM60UU	BBERM60AUU	BBERMS60UU	BBERMS60AUU	60		90	0 -25	209		95,5	134	18	112	11,0	17,0	11,1	6	25	25	9 940	20 000	12 723	28 560	4 920

5.2 SNR Super ball bushings

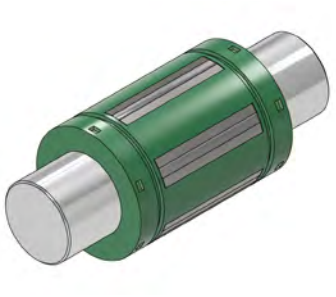
5.2.1 Super ball bushings with self-alignment BBET_UU, closed, ISO dimension

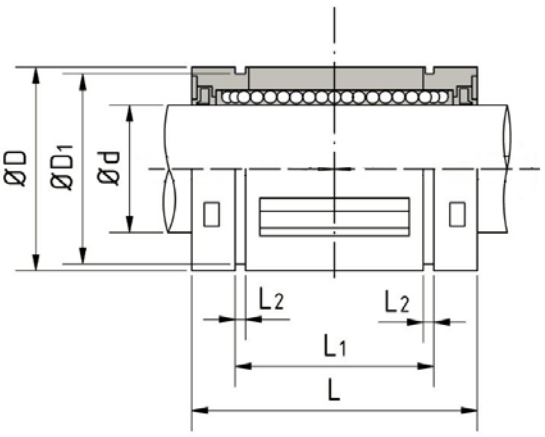


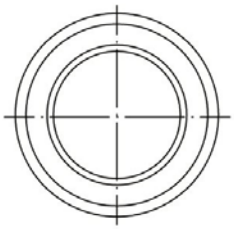


	d	Tolerance	D	L	Tolerance	L1	Tolerance	L2	D1	Number of ball rows	Dynamic load rating C	Static load rating C0	Dynamic load rating C_{max}	Static load rating $C0_{max}$	Weight
	[mm]	[µm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]		[N]	[N]	[N]	[N]	[g]
BBET8UU	8	+8 0	16	25	±0,2	16,5	0 -0,2	1,10	15,2	4	423	534	598	755	7
BBET10UU	10		19	29		22,0		1,30	18,0	5	750	935	1 097	1 368	14
BBET12UU	12		22	32		22,9		1,30	21,0	5	1 020	1 290	1 492	1 887	21
BBET16UU	16	+9 -1	26	36		24,9		1,30	24,9	5	1 250	1 550	1 829	2 268	43
BBET20UU	20		32	45		31,5		1,60	30,3	6	2 090	2 630	2 675	3 366	58
BBET25UU	25	+11 -1	40	58		44,1	0 -0,3	1,85	37,5	6	3 780	4 720	4 838	6 042	123
BBET30UU	30		47	68		52,1		1,85	44,5	6	5 470	6 810	7 002	8 717	216
BBET40UU	40	+13 -2	62	80		60,6		2,15	59,0	6	6 590	8 230	8 435	10 534	333
BBET50UU	50		75	100		77,6		2,65	72,0	6	10 800	13 500	13 824	17 280	618

5.2.2 Super ball bushings without self-alignment BBEW_UU, closed, ISO dimension

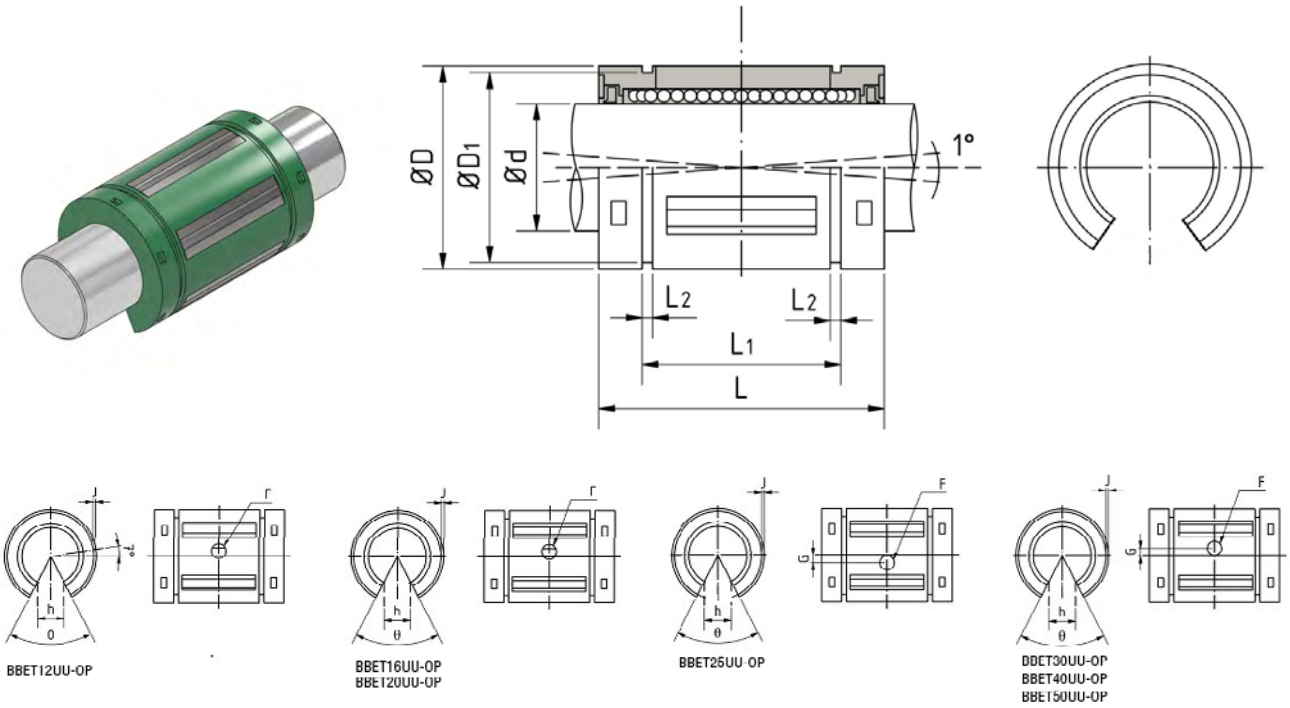






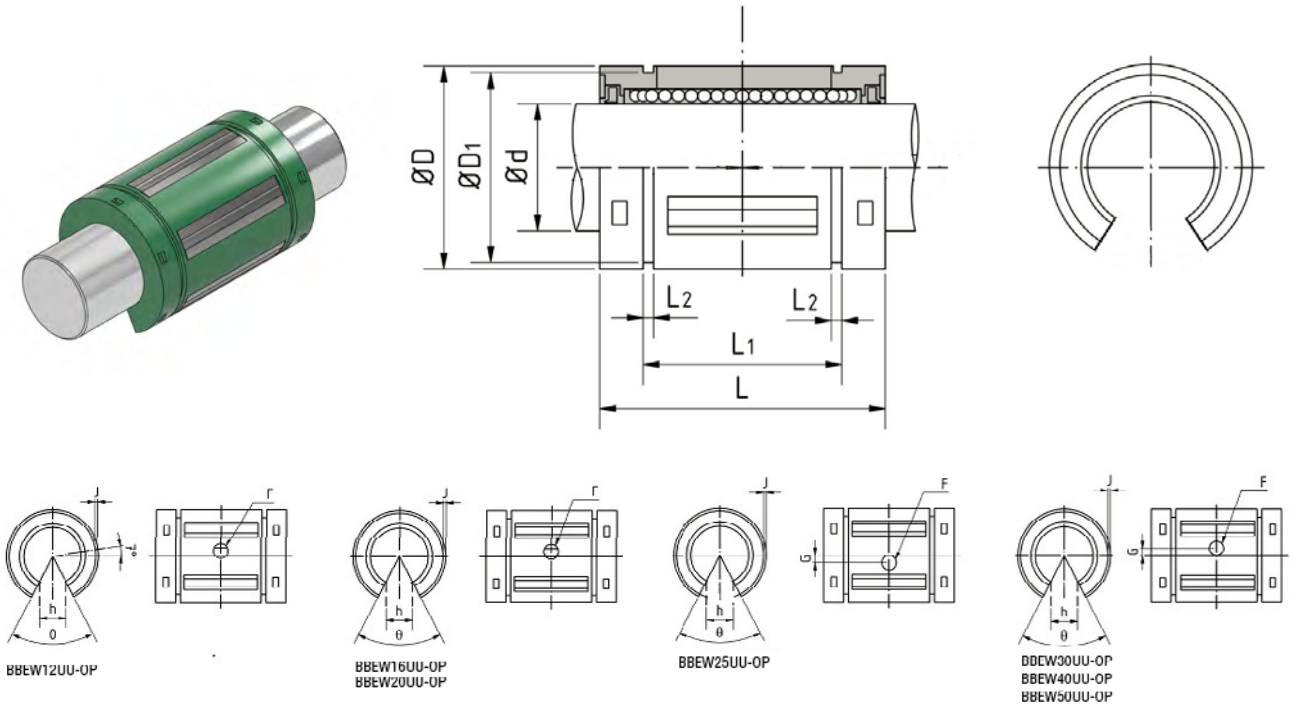
	d	Tolerance	D	L	Tolerance	L1	Tolerance	L2	D1	Number of ball rows	Dynamic load rating C	Static load rating C0	Dynamic load rating C_{max}	Static load rating $C0_{max}$	Weight
	[mm]	[µm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]		[N]	[N]	[N]	[N]	[g]
BBEW8UU	8	+8 0	16	25	±0,2	16,5	0 -0,2	1,10	15,2	4	423	534	598	755	7
BBEW10UU	10		19	29		22,0		1,30	18,0	5	750	935	1 097	1 368	14
BBEW12UU	12		22	32		22,9		1,30	21,0	5	1 020	1 290	1 492	1 887	21
BBEW16UU	16	+9 -1	26	36		24,9		1,30	24,9	5	1 250	1 550	1 829	2 268	43
BBEW20UU	20		32	45		31,5		1,60	30,3	6	2 090	2 630	2 675	3 366	58
BBEW25UU	25	+11 -1	40	58		44,1	0 -0,3	1,85	37,5	6	3 780	4 720	4 838	6 042	123
BBEW30UU	30		47	68		52,1		1,85	44,5	6	5 470	6 810	7 002	8 717	216
BBEW40UU	40	+13 -2	62	80		60,6		2,15	59,0	6	6 590	8 230	8 435	10 534	333
BBEW50UU	50		75	100		77,6		2,65	72,0	6	10 800	13 500	13 824	17 280	618

5.2.3 Super ball bushings with self-alignment BBET_UU-OP, open, ISO dimension



	d	Tolerance	D	L	Tolerance	L1	Tolerance	L2	D1	h	Q	F H11	G	J	Number of ball rows	Radial dynamic load rating C	Radial static load rating C0	Reverse radial dynamic load rating C	Reverse radial static load rating C0	Weight
	[mm]	[µm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[°]	[mm]	[mm]	[mm]		[N]	[N]	[N]	[N]	[g]
BBET12UU-OP	12	+8 0	22	32	±0,2	22,9	0 -0,2	1,30	21,0	6,5	66	3	-	0,7	4	1 020	1 290	551	697	21
BBET16UU-OP	16	+9 -1	26	36		24,9		1,30	24,9	9,0	68	3	-	1,0	4	1 250	1 550	675	837	43
BBET20UU-OP	20		32	45		31,5		1,60	30,3	9,0	55	3	-	1,0	5	2 090	2 630	1 191	1 499	58
BBET25UU-OP	25	+11 -1	40	58		44,1	0 -0,3	1,85	37,5	11,5	57	3	1,5	1,5	5	3 780	4 720	2 155	2 690	123
BBET30UU-OP	30		47	68		52,1		1,85	44,5	14,0	57	3	2,0	1,7	5	5 470	6 810	3 118	3 882	216
BBET40UU-OP	40	+13 -2	62	80		60,6		2,15	59,0	19,5	56	3	1,5	2,4	5	6 590	8 230	3 756	4 691	333
BBET50UU-OP	50		75	100		77,6		2,65	72,0	22,5	54	5	2,5	2,7	5	10 800	13 500	6 156	7 695	618

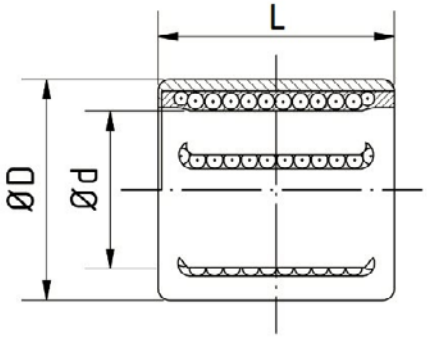
5.2.4 Super ball bushings without self-alignment BBEW_UU-OP, open, ISO dimension

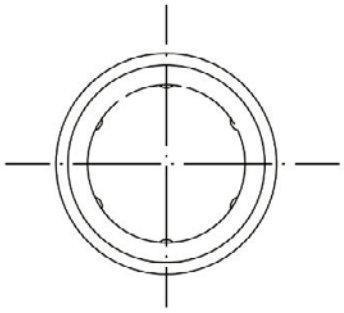


	d	Tolerance	D	L	Tolerance	L1	Tolerance	L2	D1	h	Q	F H11	G	J	Number of ball rows	Radial dynamic load rating C	Radial static load rating C0	Reverse radial dynamic load rating C	Reverse radial static load rating C0	Weight
	[mm]	[µm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[°]	[mm]	[mm]	[mm]		[N]	[N]	[N]	[N]	[g]
BBEW12UU-OP	12	+8 0	22	32	±0,2	22,9	0 -0,2	1,30	21,0	6,5	66	3	-	0,7	4	1 020	1 290	551	697	21
BBEW16UU-OP	16	+9 -1	26	36		24,9		1,30	24,9	9,0	68	3	-	1,0	4	1 250	1 550	675	837	43
BBEW20UU-OP	20		32	45		31,5		1,60	30,3	9,0	55	3	-	1,0	5	2 090	2 630	1 191	1 499	58
BBEW25UU-OP	25	+11 -1	40	58		44,1	0 -0,3	1,85	37,5	11,5	57	3	1,5	1,5	5	3 780	4 720	2 155	2 690	123
BBEW30UU-OP	30		47	68		52,1		1,85	44,5	14,0	57	3	2,0	1,7	5	5 470	6 810	3 118	3 882	216
BBEW40UU-OP	40	+13 -2	62	80		60,6		2,15	59,0	19,5	56	3	1,5	2,4	5	6 590	8 230	3 756	4 691	333
BBEW50UU-OP	50		75	100		77,6		2,65	72,0	22,5	54	5	2,5	2,7	5	10 800	13 500	6 156	7 695	618

5.3 NTN Ball sleeves

5.3.1 Ball sleeves KH_LL/3AS, ISO dimension

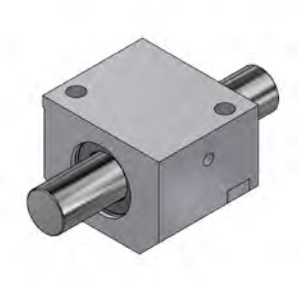


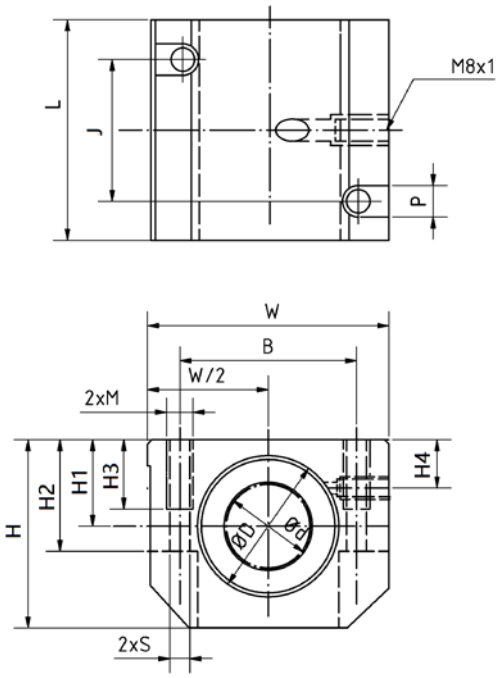


	d	D	L	Number of ball rows	Dynamic load rating C	Static load rating C0	Weight
	[mm]	[mm]	[mm]		[N]	[N]	[g]
KH1228LL/3AS	12	19	28	5	605	495	18
KH1428LL/3AS	14	21	28	5	600	505	21
KH1630LL/3AS	16	24	30	5	775	600	27
KH2030LL/3AS	20	28	30	6	1 050	880	33
KH2540LL/3AS	25	35	40	6	1 930	1 560	66
KH3050LL/3AS	30	40	50	7	2 700	2 450	95
KH4060LL/3AS	40	52	60	8	4 250	4 000	180
KH5070LL/3AS	50	62	70	9	5 300	5 300	240

5.4 SNR Linear units with standard ball bushings

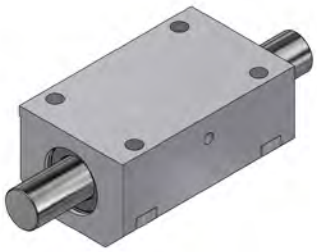
5.4.1 Linear unit with standard ball bushing LSE_UU, closed

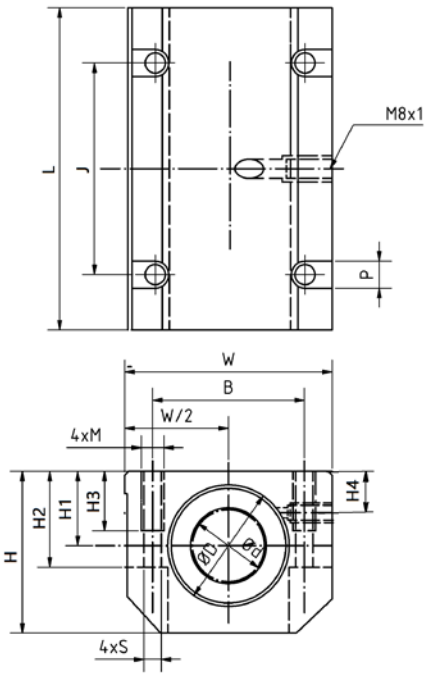




	d	D H6	H1 +0,01 -0,02	W	L +0,3 0,0	B	J	H	H2	H4	M	P	H3	S	Dynamic load rating C	Static load rating C0	Weight
	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]		[mm]	[mm]	[mm]	[N]	[N]	[g]
LSE12UU	12	22	18	43	39	32	23	35	25	10	M5	8	11	4,2	416	784	175
LSE16UU	16	26	22	53	43	40	26	42	30	12	M6	10	13	5,2	432	892	260
LSE20UU	20	32	25	60	54	45	32	50	34	13	M8	11	18	6,8	877	1 370	442
LSE25UU	25	40	30	78	67	60	40	60	40	15	M10	15	22	8,6	908	1 570	885
LSE30UU	30	47	35	87	79	68	45	70	48	16	M10	15	22	8,6	1 584	2 740	1 330
LSE40UU	40	62	45	108	91	86	58	90	60	20	M12	18	26	10,3	2 357	4 020	2 570

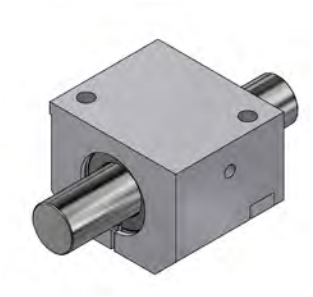
5.4.2 Tandem linear unit with standard ball bushing LSE_LUU, closed

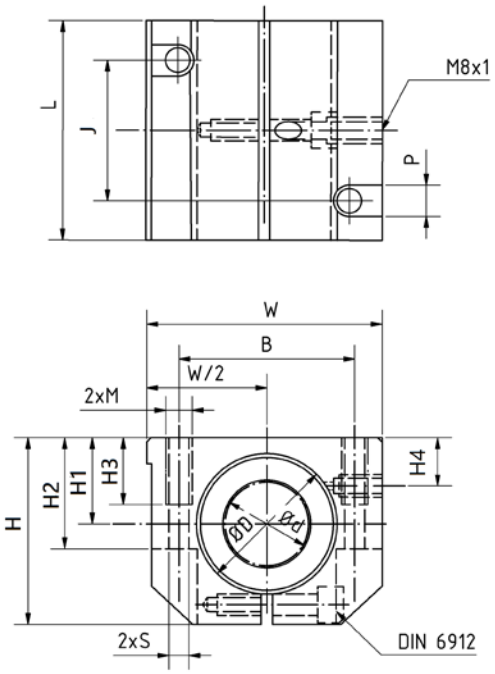




	d	D H6	H1 +0,01 -0,02	W	L +0,3 0,0	B	J	H	H2	H4	M	P	H3	S	Dynamic load rating C	Static load rating C0	Weight
	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]		[mm]	[mm]	[mm]	[N]	[N]	[g]
LSE12LUU	12	22	18	43	76	32	56	35	25	10	M5	8	11	4,2	683	1 570	360
LSE16LUU	16	26	22	53	84	40	64	42	30	12	M6	10	13	5,2	710	1 780	530
LSE20LUU	20	32	25	60	104	45	76	50	34	13	M8	11	18	6,8	1 440	2 740	920
LSE25LUU	25	40	30	78	130	60	94	60	40	15	M10	15	22	8,6	1 490	3 140	1 820
LSE30LUU	30	47	35	87	152	68	106	70	48	16	M10	15	22	8,6	2 600	5 490	2 730
LSE40LUU	40	62	45	108	176	86	124	90	60	20	M12	18	26	10,3	3 872	8 040	5 210

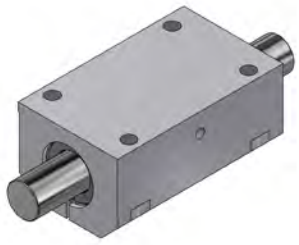
5.4.3 Linear unit with standard ball bushing LSE_UU-AJ, closed, radial clearance adjustable

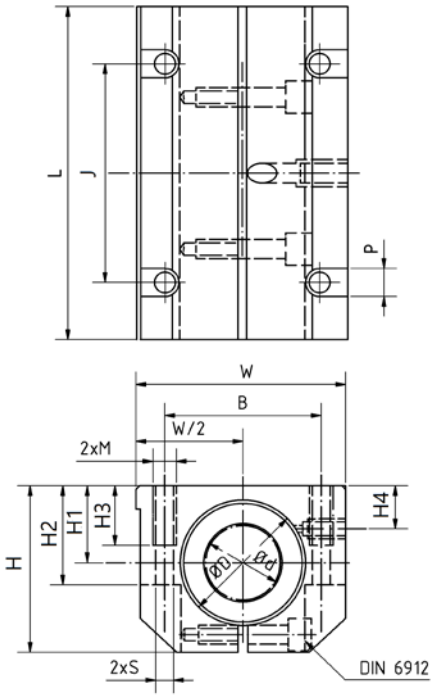




	d	D H6	H1 +0,01 -0,02	W	L +0,3 0,0	B	J	H	H2	H4	M	P	H3	S	Dynamic load rating C	Static load rating C0	Weight
	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]		[mm]	[mm]	[mm]	[N]	[N]	[g]
LSE12UU-AJ	12	22	18	43	39	32	23	35	25	10	M5	8	11	4,2	416	784	175
LSE16UU-AJ	16	26	22	53	43	40	26	42	30	12	M6	10	13	5,2	432	892	260
LSE20UU-AJ	20	32	25	60	54	45	32	50	34	13	M8	11	18	6,8	877	1 370	442
LSE25UU-AJ	25	40	30	78	67	60	40	60	40	15	M10	15	22	8,6	908	1 570	885
LSE30UU-AJ	30	47	35	87	79	68	45	70	48	16	M10	15	22	8,6	1 584	2 740	1 330
LSE40UU-AJ	40	62	45	108	91	86	58	90	60	20	M12	18	26	10,3	2 357	4 020	2 570

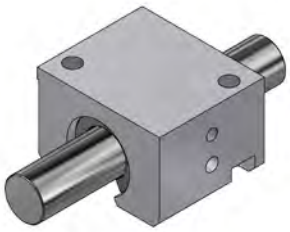
5.4.4 Tandem linear unit with standard ball bushing LSE_LUU-AJ, closed, radial clearance adjustable

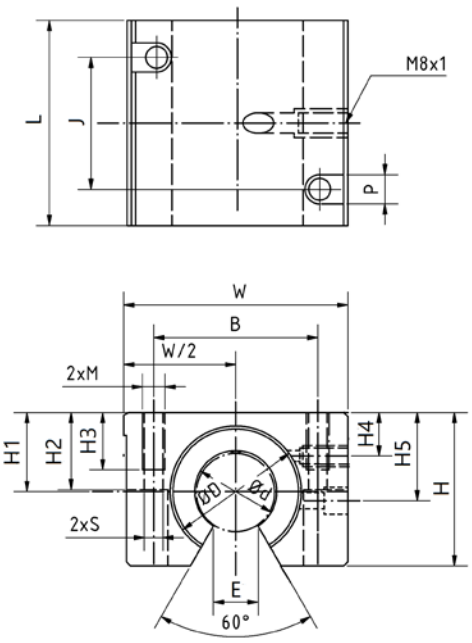




	d	D H6	H1 +0,01 -0,02	W	L +0,3 0,0	B	J	H	H2	H4	M	P	H3	S	Dynamic load rating C	Static load rating C0	Weight
	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]		[mm]	[mm]	[mm]	[N]	[N]	[g]
LSE12LUU-AJ	12	22	18	43	76	32	56	35	25	10	M5	8	11	4,2	683	1 570	360
LSE16LUU-AJ	16	26	22	53	84	40	64	42	30	12	M6	10	13	5,2	710	1 780	530
LSE20LUU-AJ	20	32	25	60	104	45	76	50	34	13	M8	11	18	6,8	1 440	2 740	920
LSE25LUU-AJ	25	40	30	78	130	60	94	60	40	15	M10	15	22	8,6	1 490	3 140	1 820
LSE30LUU-AJ	30	47	35	87	152	68	106	70	48	16	M10	15	22	8,6	2 600	5 490	2 730
LSE40LUU-AJ	40	62	45	108	176	86	124	90	60	20	M12	18	26	10,3	3 872	8 040	5 210

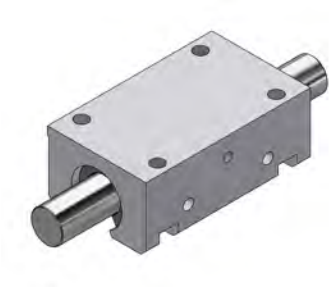
5.4.5 Linear unit with standard ball bushing LSE_UU-OP, open

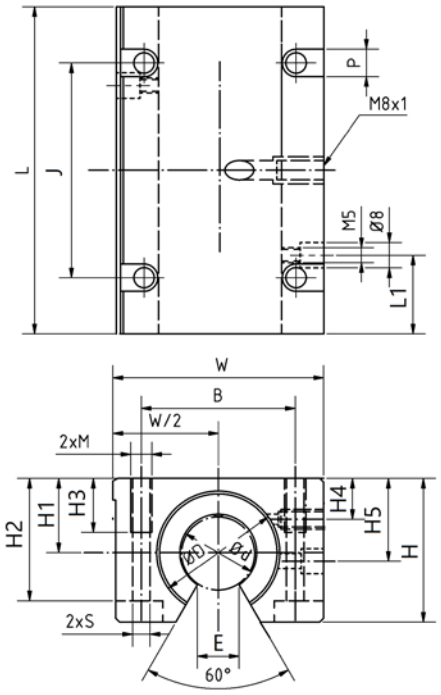




	d	D H6	H1 +0,01 -0,02	W	L +0,3 0,0	B	J	H	H2	H4	H5	M	E +0,6 0,0	P	H3	S	Radial dynamic load rating C	Radial static load rating C0	Reverse radial dynamic load rating C	Reverse radial static load rating C0	Weight
	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]		[mm]	[mm]	[mm]	[mm]	[N]	[N]	[N]	[N]	[g]
LSE12UU-OP	12	22	18	43	39	32	23	28	23,5	8	16,65	M5	7,0	8	11	4,2	416	784	266	502	145
LSE16UU-OP	16	26	22	53	43	40	26	35	30,0	12	22,00	M6	9,4	10	13	5,2	432	892	276	571	218
LSE20UU-OP	20	32	25	60	54	45	32	42	34,0	13	25,00	M8	10,2	11	18	6,8	877	1 370	474	740	384
LSE25UU-OP	25	40	30	78	67	60	40	51	40,0	15	31,50	M10	12,9	15	22	8,6	908	1 570	518	895	765
LSE30UU-OP	30	47	35	87	79	68	45	60	48,0	16	33,00	M10	14,4	15	22	8,6	1 584	2 740	903	1 562	1 170
LSE40UU-OP	40	62	45	108	91	86	58	77	60,0	20	43,50	M12	18,2	18	26	10,3	2 357	4 020	1 343	2 291	2 265

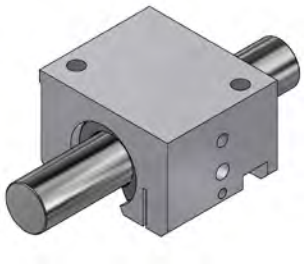
5.4.6 Tandem linear unit with standard ball bushing LSE_LUU-OP, open

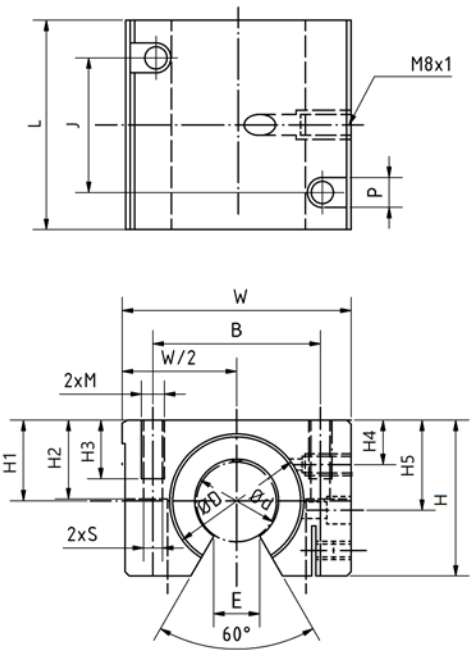




	d	D H6	H1 +0,01 -0,02	W	L +0,3 0,0	L1	B	J	H	H2	H4	H5	M	E +0,6 0,0	P	H3	S	Radial dynamic load rating C	Radial static load rating C0	Reverse radial dynamic load rating C	Reverse radial static load rating C0	Weight
	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]		[mm]	[mm]	[mm]	[mm]	[N]	[N]	[N]	[N]	[g]
LSE12LUU-OP	12	22	18	43	76	19,5	32	56	28	23,5	8	16,65	M5	7,0	8	11	4,2	683	1 570	437	1 005	290
LSE16LUU-OP	16	26	22	53	84	21,5	40	64	35	30,0	12	22,00	M6	9,4	10	13	5,2	710	1 780	454	1 139	440
LSE20LUU-OP	20	32	25	60	104	27,0	45	76	42	34,0	13	25,00	M8	10,2	11	18	6,8	1 440	2 740	778	1 480	790
LSE25LUU-OP	25	40	30	78	130	33,5	60	94	51	40,0	15	31,50	M10	12,9	15	22	8,6	1 490	3 140	849	1 570	1 560
LSE30LUU-OP	30	47	35	87	152	39,5	68	106	60	48,0	16	33,00	M10	14,4	15	22	8,6	2 600	5 490	1 482	2 745	2 300
LSE40LUU-OP	40	62	45	108	176	45,5	86	124	77	60,0	20	43,50	M12	18,2	18	26	10,3	3 872	8 040	2 207	4 020	4 500

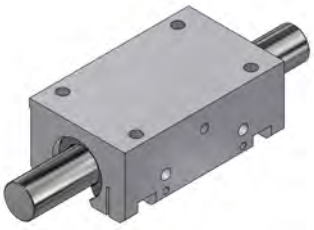
5.4.7 Linear unit with standard ball bushing LSE_UU-AO, open, radial clearance adjustable

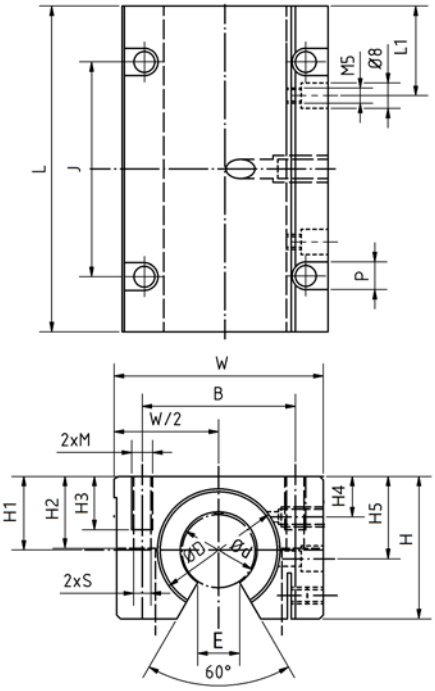




	d	D H6	H1 +0,01 -0,02	W	L +0,3 0,0	B	J	H	H2	H4	H5	M	E +0,6 0,0	P	H3	S	Radial dynamic load rating C	Radial static load rating C0	Reverse radial dynamic load rating C	Reverse radial static load rating C0	Weight
	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]		[mm]	[mm]	[mm]	[mm]	[N]	[N]	[N]	[N]	[g]
LSE12UU-AO	12	22	18	43	39	32	23	28	23,5	8	16,65	M5	7,0	8	11	4,2	416	784	266	502	145
LSE16UU-AO	16	26	22	53	43	40	26	35	30,0	12	22,00	M6	9,4	10	13	5,2	432	892	276	571	218
LSE20UU-AO	20	32	25	60	54	45	32	42	34,0	13	25,00	M8	10,2	11	18	6,8	877	1 370	474	740	384
LSE25UU-AO	25	40	30	78	67	60	40	51	40,0	15	31,50	M10	12,9	15	22	8,6	908	1 570	518	895	765
LSE30UU-AO	30	47	35	87	79	68	45	60	48,0	16	33,00	M10	14,4	15	22	8,6	1 584	2 740	903	1 562	1 170
LSE40UU-AO	40	62	45	108	91	86	58	77	60,0	20	43,50	M12	18,2	18	26	10,3	2 357	4 020	1 343	2 291	2 265

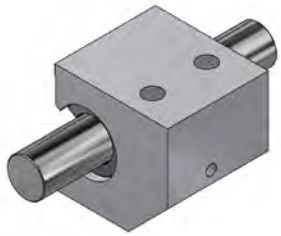
5.4.8 Tandem linear unit with standard ball bushing LSE_LUU-AO, open, radial clearance adjustable

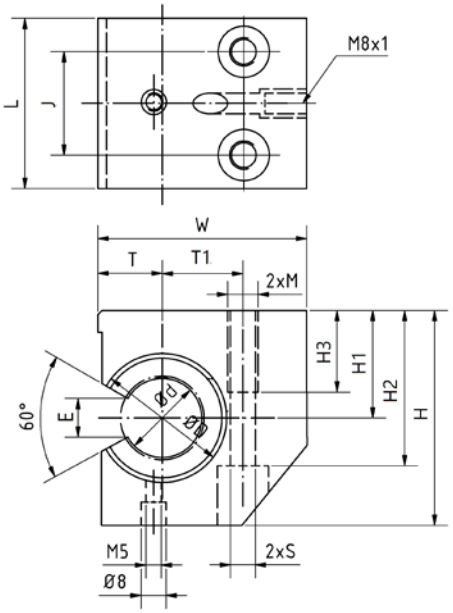




	d	D H6	H1 +0,01 -0,02	W	L +0,3 0,0	L1	B	J	H	H2	H4	H5	M	E +0,6 0,0	P	H3	S	Radial dynamic load rating C	Radial static load rating C0	Reverse radial dynamic load rating C	Reverse radial static load rating C0	Weight
	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]		[mm]	[mm]	[mm]	[mm]	[N]	[N]	[N]	[N]	[g]
LSE12LUU-AO	12	22	18	43	76	19,5	32	56	28	23,5	8	16,65	M5	7,0	8	11	4,2	683	1 570	437	1 005	290
LSE16LUU-AO	16	26	22	53	84	21,5	40	64	35	30,0	12	22,00	M6	9,4	10	13	5,2	710	1 780	454	1 139	440
LSE20LUU-AO	20	32	25	60	104	27,0	45	76	42	34,0	13	25,00	M8	10,2	11	18	6,8	1 440	2 740	778	1 480	790
LSE25LUU-AO	25	40	30	78	130	33,5	60	94	51	40,0	15	31,50	M10	12,9	15	22	8,6	1 490	3 140	849	1 570	1 560
LSE30LUU-AO	30	47	35	87	152	39,5	68	106	60	48,0	16	33,00	M10	14,4	15	22	8,6	2 600	5 490	1 482	2 745	2 300
LSE40LUU-AO	40	62	45	108	176	45,5	86	124	77	60,0	20	43,50	M12	18,2	18	26	10,3	3 872	8 040	2 207	4 020	4 500

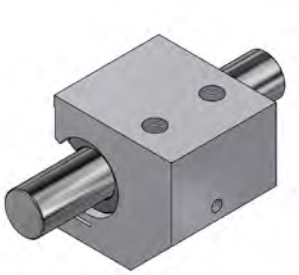
5.4.9 Linear unit with standard ball bushing LSE_UU-SOP, lateral open

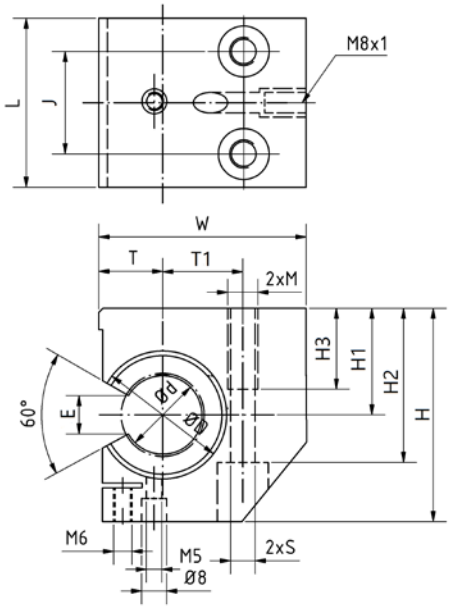




	d	D H6	H1 ±0,015	W	L +0,3 0,0	J	H	H2	H3	M	E +0,6 0,0	T +0,02 -0,02	T1	S	Radial dynamic load rating C	Radial static load rating C0	Reverse radial dynamic load rating C	Reverse radial static load rating C0	Weight
	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]		[mm]	[mm]	[mm]	[mm]	[N]	[N]	[N]	[N]	[g]
LSE20UU-SOP	20	32	30	60	54	30	60	42	22	M10	10,2	17	22	8,6	877	1 370	474	740	504
LSE25UU-SOP	25	40	35	75	67	36	75	50	26	M12	12,5	21	28	10,3	908	1 570	518	895	995
LSE30UU-SOP	30	47	40	86	79	42	82	55	34	M16	13,9	25	34	13,5	1 584	2 740	903	1 562	1 510
LSE40UU-SOP	40	62	45	110	91	48	100	67	43	M20	18,0	32	43	17,5	2 357	4 020	1 343	2 291	2 665

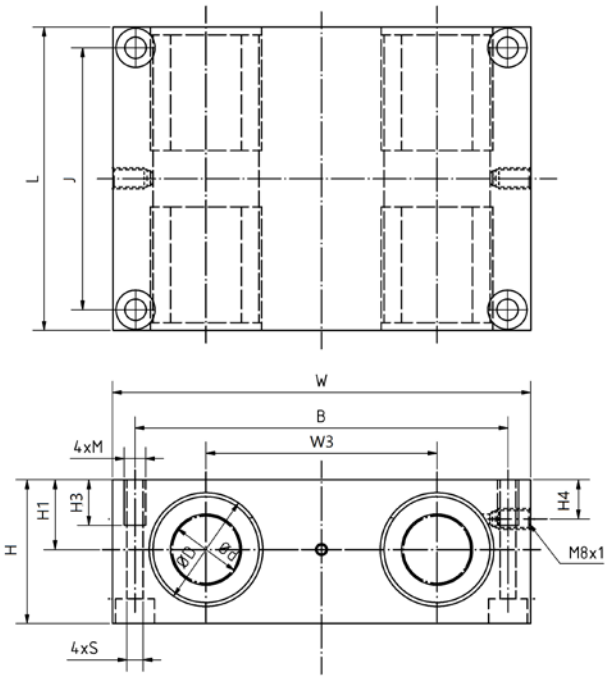
5.4.10 Linear unit with standard ball bushing LSE_UU-SAO, lateral open, radial clearance adjustable





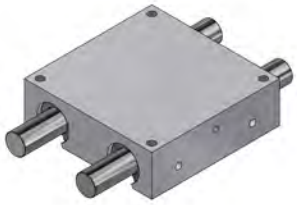
	d	D H6	H1 ±0,015	W	L +0,3 0,0	J	H	H2	H3	M	E +0,6 0,0	T +0,02 -0,02	T1	S	Radial dynamic load rating C	Radial static load rating C0	Reverse radial dynamic load rating C	Reverse radial static load rating C0	Weight
	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]		[mm]	[mm]	[mm]	[mm]	[N]	[N]	[N]	[N]	[g]
LSE20UU-SAO	20	32	30	60	54	30	60	42	22	M10	10,2	17	22	8,6	877	1 370	474	740	504
LSE25UU-SAO	25	40	35	75	67	36	75	50	26	M12	12,5	21	28	10,3	908	1 570	518	895	995
LSE30UU-SAO	30	47	40	86	79	42	82	55	34	M16	13,9	25	34	13,5	1 584	2 740	903	1 562	1 510
LSE40UU-SAO	40	62	45	110	91	48	100	67	43	M20	18,0	32	43	17,5	2 357	4 020	1 343	2 291	2 665

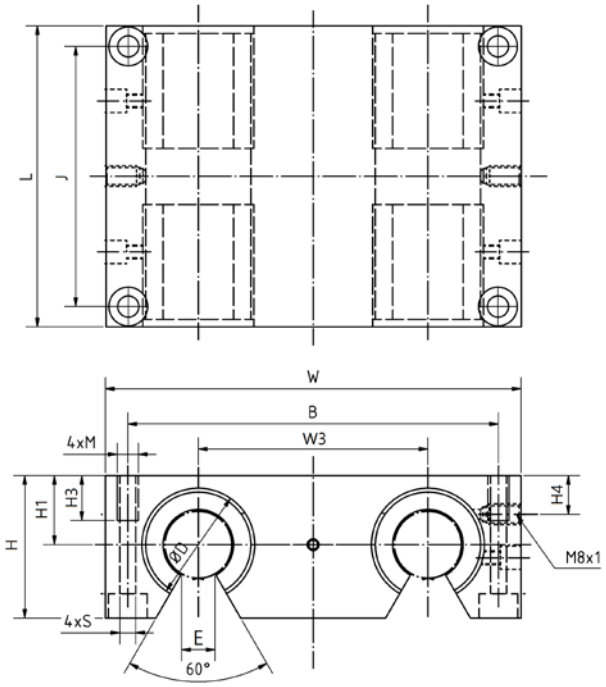
5.4.11 Quattro linear unit with standard ball bushings LSE_QUU, closed



	d	D H6	H1 +0,01 -0,02	W	L +0,3 0,0	B	J	H	W3 ±0,02	M	H3	H4	S	Dynamic load rating C	Static load rating C0	Weight
	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]		[mm]	[mm]	[mm]	[N]	[N]	[g]
LSE12QUU	12	22	16	85	85	73	73	32	42	M6	13	13	5,3	1 300	2 000	700
LSE16QUU	16	26	18	100	100	88	88	36	54	M6	13	15	5,3	1 400	2 200	1 020
LSE20QUU	20	32	23	130	130	115	115	46	72	M8	18	19	6,8	3 200	4 900	2 150
LSE25QUU	25	40	28	160	160	140	140	56	88	M10	22	24	9,0	5 500	8 500	4 070
LSE30QUU	30	47	32	180	180	158	158	64	96	M12	26	27	10,5	6 200	9 500	5 870
LSE40QUU	40	62	40	230	230	202	202	80	122	M16	34	35	13,5	10 500	14 000	11 780

5.4.12 Quattro linear unit with standard ball bushings LSE_QUU-OP, open

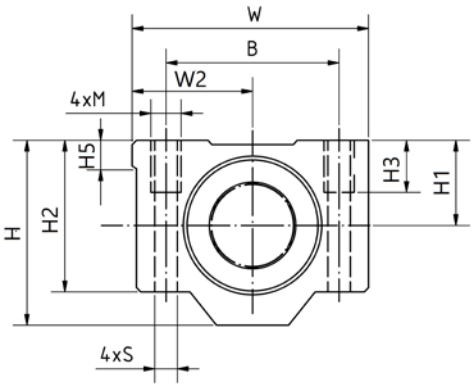


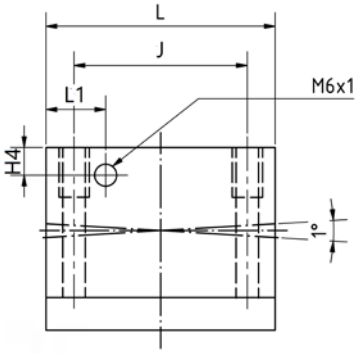


	d	D H6	H1 +0,01 -0,02	W	L +0,3 0,0	B	J	H	W3 ±0,02	E	M	H3	H4	S	Radial dynamic load rating C	Radial static load rating C0	Reverse radial dynamic load rating C	Reverse radial static load rating C0	Weight
	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]		[mm]	[mm]	[mm]	[N]	[N]	[N]	[N]	[g]
LSE12QUU-OP	12	22	18	85	85	73	73	30	42	7,0	M6	13	13	5,3	1 300	2 000	832	1 280	700
LSE16QUU-OP	16	26	22	100	100	88	88	35	54	9,4	M6	13	15	5,3	1 400	2 200	896	1 408	1 020
LSE20QUU-OP	20	32	25	130	130	115	115	42	72	10,2	M8	18	19	6,8	3 200	4 900	1 728	2 646	2 150
LSE25QUU-OP	25	40	30	160	160	140	140	51	88	12,9	M10	22	24	9,0	5 500	8 500	3 135	4 845	4 070
LSE30QUU-OP	30	47	35	180	180	158	158	60	96	13,9	M12	26	27	10,5	6 200	9 500	3 534	5 415	5 870
LSE40QUU-OP	40	62	45	230	230	202	202	77	122	18,2	M16	34	35	13,5	10 500	14 000	5 985	7 980	11 780

5.5 SNR Linear unit with super ball bushings

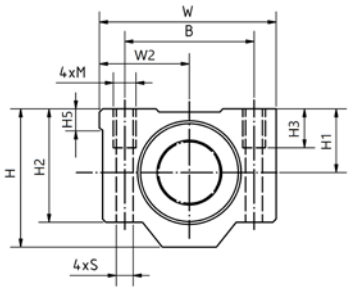
5.5.1 Linear unit with super ball bushings LSET_UU, closed

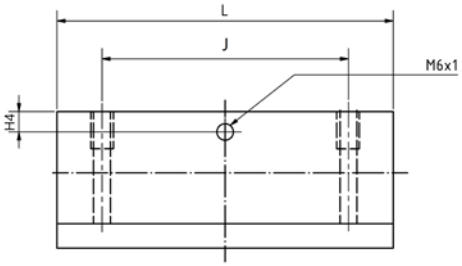




	d	H1 ±0,015	W2 ±0,015	W	L	B	J	H	H2	L1	H4	M	H3	H5	S	Dynamic load rating C	Static load rating C0	Weight
	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]		[mm]	[mm]	[mm]	[N]	[N]	[g]
LSET8UU	8	15	17,5	35	32	25	20	28,0	22	-	-	M4	9	5	3,3	423	534	59
LSET10UU	10	16	20,0	40	36	29	20	31,5	25	-	-	M5	11	5	4,3	750	935	90
LSET12UU	12	18	21,5	43	39	32	23	35,0	28	-	-	M5	11	5	4,3	1 020	1 290	116
LSET16UU	16	22	26,5	53	43	40	26	42,0	35	-	-	M6	13	5	5,3	1 250	1 550	205
LSET20UU	20	25	30,0	60	54	45	32	50,0	42	19,0	9,0	M8	18	5	6,6	2 090	2 630	326
LSET25UU	25	30	39,0	78	67	60	40	60,0	48	22,5	10,0	M10	22	7	8,4	3 780	4 720	624
LSET30UU	30	35	43,5	87	79	68	45	70,0	58	26,0	11,5	M10	22	8	8,4	5 470	6 810	980
LSET40UU	40	45	54,0	108	91	86	58	90,0	72	26,5	14,0	M12	26	10	10,5	6 590	8 230	1 670

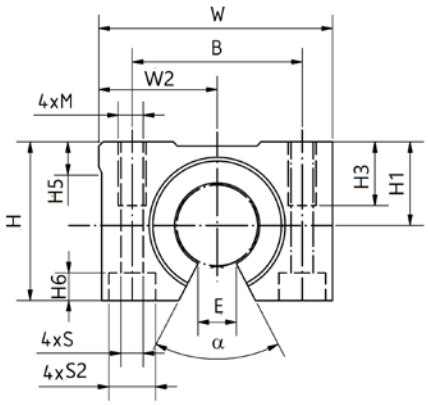
5.5.2 Tandem linear unit with super ball bushings LSET_LUU, closed

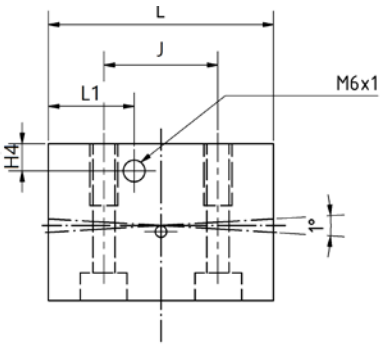




	d	H1 ±0,015	W2 ±0,015	W	L	B	J	H	H2	H4	M	H3	H5	S	Dynamic load rating C	Static load rating C0	Weight
	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]		[mm]	[mm]	[mm]	[N]	[N]	[g]
LSET8LUU	8	15	17,5	35	62	25	50	28,0	22	6,5	M4	9	5	3,3	685	1 068	119
LSET10LUU	10	16	20,0	40	70	29	52	31,5	25	7,0	M5	11	5	4,3	1 215	1 870	175
LSET12LUU	12	18	21,5	43	76	32	56	35,0	28	7,5	M5	11	5	4,3	1 652	2 580	227
LSET16LUU	16	22	26,5	53	84	40	64	42,0	35	9,5	M6	13	5	5,3	2 025	3 100	390
LSET20LUU	20	25	30,0	60	104	45	76	50,0	42	9,0	M8	18	5	6,6	3 390	5 260	630
LSET25LUU	25	30	39,0	78	130	60	94	60,0	48	10,0	M10	22	7	8,4	6 120	9 440	1 210
LSET30LUU	30	35	43,5	87	152	68	106	70,0	58	11,5	M10	22	8	8,4	8 860	13 620	1 880
LSET40LUU	40	45	54,0	108	176	86	124	90,0	72	14,0	M12	26	10	10,5	10 680	16 460	3 280

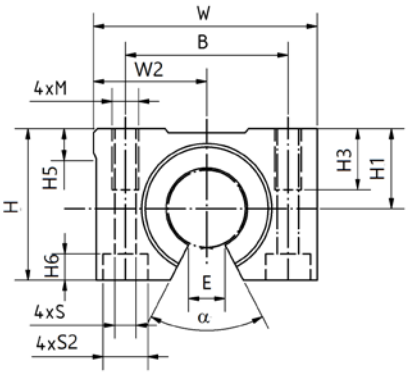
5.5.3 Linear unit with super ball bushings LSET_UU-OP, open

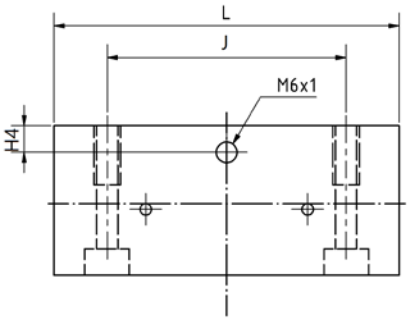




	d	H1 ±0,015	W2 ±0,015	W	L	B	J	H	L1	H4	E	a	M	H3	H5	H6	S	S2	Radial dynamic load rating C	Radial static load rating C0	Reverse radial dynamic load rating C	Reverse radial static load rating C0	Weight
	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[°]		[mm]	[mm]	[mm]	[mm]	[mm]	[N]	[N]	[N]	[N]	[g]
LSET12UU-OP	12	18	21,5	43	39	32	23	28	14,5	7,5	6,5	66	M5	11	5	4,5	4,3	8,0	1 020	1 290	551	697	99
LSET16UU-OP	16	22	26,5	53	43	40	26	35	15,5	9,5	9,0	68	M6	13	5	5,5	5,3	9,5	1 250	1 550	675	837	175
LSET20UU-OP	20	25	30,0	60	54	45	32	42	19,0	9,0	9,0	55	M8	18	5	6,5	6,6	11,0	2 090	2 630	1 191	1 499	275
LSET25UU-OP	25	30	39,0	78	67	60	40	51	22,5	10,0	11,5	57	M10	22	7	8,6	8,4	14,0	3 780	4 720	2 155	2 690	558
LSET30UU-OP	30	35	43,5	87	79	68	45	60	26,0	11,5	14,0	57	M10	22	8	8,6	8,4	14,0	5 470	6 810	3 118	3 882	860
LSET40UU-OP	40	45	54,0	108	91	86	58	77	26,5	14,0	19,5	56	M12	26	10	10,8	10,5	17,5	6 590	8 230	3 756	4 691	1 490

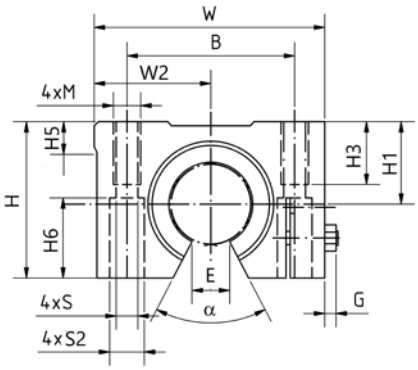
5.5.4 Tandem linear unit with super ball bushings LSET_LUU-OP, open

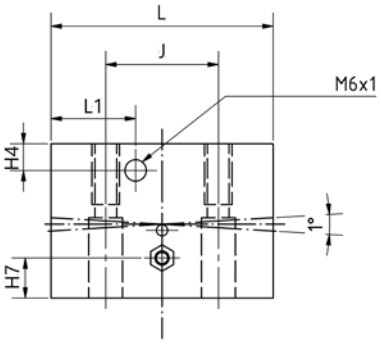




	d	H1 ±0,015	W2 ±0,015	W	L	B	J	H	H4	E	a	M	H3	H5	H6	S	S2	Radial dynamic load rating C	Radial static load rating C0	Reverse radial dynamic load rating C	Reverse radial static load rating C0	Weight
	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[°]		[mm]	[mm]	[mm]	[mm]	[mm]	[N]	[N]	[N]	[N]	[g]
LSET12LUU-OP	12	18	21,5	43	76	32	56	28	7,5	6,5	66	M5	11	5	4,5	4,3	8,0	1 652	2 580	892	1 393	190
LSET16LUU-OP	16	22	26,5	53	84	40	64	35	9,5	9,0	68	M6	13	5	5,5	5,3	9,5	2 025	3 100	1 094	1 674	312
LSET20LUU-OP	20	25	30,0	60	104	45	76	42	9,0	9,0	55	M8	18	5	6,5	6,6	11,0	3 390	5 260	1 932	2 998	505
LSET25LUU-OP	25	30	39,0	78	130	60	94	51	10,0	11,5	57	M10	22	7	8,6	8,4	14,0	6 120	9 440	3 488	5 381	1 050
LSET30LUU-OP	30	35	43,5	87	152	68	106	60	11,5	14,0	57	M10	22	8	8,6	8,4	14,0	8 860	13 620	5 050	7 763	1 630
LSET40LUU-OP	40	45	54,0	108	176	86	124	77	14,0	19,5	56	M12	26	10	10,8	10,5	17,5	10 680	16 460	6 088	9 382	2 880

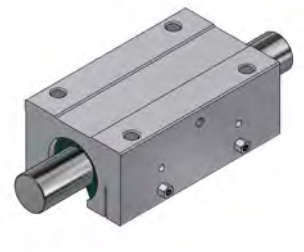
5.5.5 Linear unit with super ball bushings LSET_UU-AO, open, radial clearance adjustable

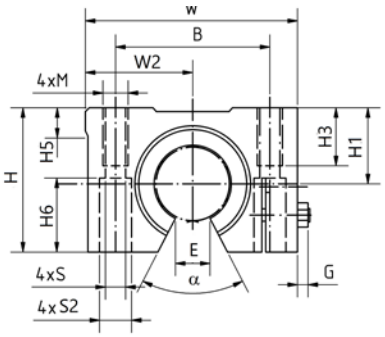


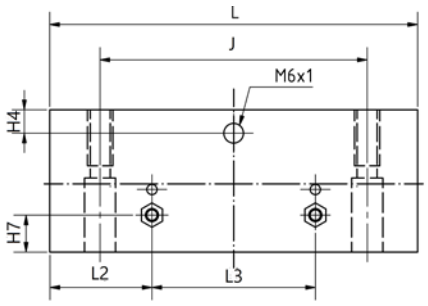


	d	H1 ±0,015	W2 ±0,015	W	L	B	J	H	L1	H4	E	a	M	H3	H5	H6	S	S2	H7	G	Radial dynamic load rating C	Radial static load rating C0	Reverse radial dynamic load rating C	Reverse radial static load rating C0	Weight
	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[°]		[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[N]	[N]	[N]	[N]	[g]
LSET12UU-AO	12	18	21,5	43	39	32	23	28	14,5	7,5	6,5	66	M5	11	5	11,5	4,3	8,0	5	3,2	1 020	1 290	551	697	99
LSET16UU-AO	16	22	26,5	53	43	40	26	35	15,5	9,5	9,0	68	M6	13	5	14,0	5,3	9,5	6	3,2	1 250	1 550	675	837	175
LSET20UU-AO	20	25	30,0	60	54	45	32	42	19,0	9,0	9,0	55	M8	18	5	18,0	6,6	11,0	8	4,5	2 090	2 630	1 191	1 499	275
LSET25UU-AO	25	30	39,0	78	67	60	40	51	22,5	10,0	11,5	57	M10	22	7	22,0	8,4	14,0	10	5,5	3 780	4 720	2 155	2 690	558
LSET30UU-AO	30	35	43,5	87	79	68	45	60	26,0	11,5	14,0	57	M10	22	8	26,0	8,4	14,0	12	5,5	5 470	6 810	3 118	3 882	860
LSET40UU-AO	40	45	54,0	108	91	86	58	77	26,5	14,0	19,5	56	M12	26	10	33,0	10,5	17,5	15	5,0	6 590	8 230	3 756	4 691	1 490

5.5.6 Tandem linear unit with super ball bushings LSET_LUU-AO, open, radial clearance adjustable







	d	H1 ±0,015	W2 ±0,015	W	L	B	J	H	L2	L3	H4	E	a	M	H3	H5	H6	S	S2	H7	G	Radial dynamic load rating C	Radial static load rating C0	Reverse radial dynamic load rating C	Reverse radial static load rating C0	Weight
	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[°]		[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[N]	[N]	[N]	[N]	[g]
LSET12LUU-AO	12	18	21,5	43	76	32	56	28	19,5	37	7,5	6,5	66	M5	11	5	11,5	4,3	8,0	5	3,2	1 652	2 580	892	1 393	190
LSET16LUU-AO	16	22	26,5	53	84	40	64	35	21,5	41	9,5	9,0	68	M6	13	5	14,0	5,3	9,5	6	3,2	2 025	3 100	1 094	1 674	312
LSET20LUU-AO	20	25	30,0	60	104	45	76	42	27,0	50	9,0	9,0	55	M8	18	5	18,0	6,6	11,0	8	4,5	3 390	5 260	1 932	2 998	505
LSET25LUU-AO	25	30	39,0	78	130	60	94	51	33,5	63	10,0	11,5	57	M10	22	7	22,0	8,4	14,0	10	5,5	6 120	9 440	3 488	5 381	1 050
LSET30LUU-AO	30	35	43,5	87	152	68	106	60	39,5	73	11,5	14,0	57	M10	22	8	26,0	8,4	14,0	12	5,5	8 860	13 620	5 050	7 763	1 630
LSET40LUU-AO	40	45	54,0	108	176	86	124	77	45,5	85	14,0	19,5	56	M12	26	10	33,0	10,5	17,5	15	5,0	10 680	16 460	6 088	9 382	2 880

6 Accessories

6.1 Shafts

6.1.1 Shaft materials

Inductive hardened precision shafts are used for the movement of ball bushings. These precision shafts are available as solid and hollow shafts.
Precision shafts can be manufactured from various materials. Table 6.1 contains an overview of the available materials.

Table 6.1 — Shaft materials for precision shafts

Version	Material	Available shaft diameters	Tolerance	Hardness
		[mm]		[HRC]
Solid shaft	Cf53	4, 5, 6, 8, 10, 12, 14, 16, 20, 25, 30, 35, 40, 50, 60, 80	h6	> 59
	X90CrMoV18	4, 5, 6, 8, 10, 12, 14, 16, 20, 25, 30, 35, 40, 50, 60	h6	> 54*
	X46Cr13	4, 5, 6, 8, 10, 12, 14, 16, 20, 25, 30, 35, 40, 50, 60	h6	> 52*
	Cf53 hard chrome coating	4, 5, 6, 8, 10, 12, 14, 16, 20, 25, 30, 35, 40, 50, 60, 80	h7	> 59
Hollow shaft	C60	12, 16, 20, 25, 30, 40, 50, 60	h6	> 59
	C60 hard chrome coating	16, 20, 25, 30, 40, 50	h7	> 59

* The hardness factor fh must be taken into account when calculating the static safety and nominal life time.

6.1.2 Tolerances and dimensions

Depending on the material and diameter, precision shafts have different tolerances as shown in Figure 6.1.

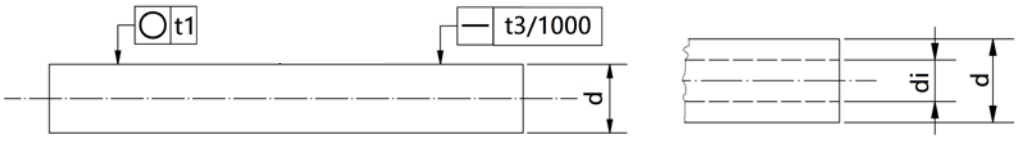


Figure 6.1 — Tolerances and dimensions from precision shafts

Δd·max

The tolerances and dimensions are summarized in Tables 6.2 to 6.5.

Table 6.2 — Tolerances and dimensions of solid shafts made of Cf53, X90CrMoV18 and X46Cr13

Type	Shaft diameter	Tolerance			Surface hardening depth	Weight	Max. shaft length
		Roundness	Diameter variation	Straightness			
	d [mm]	t1 [µm]	Δd·max [µm/1000mm]	t3 [µm]	SHD [mm]	[kg/m]	Lmax [mm]
W4	4	4	5	0,3	0,4	0,098	3
W5	5	4	5	0,3	0,4	0,154	3
W6	6	4	5	0,3	0,4	0,222	6
W8	8	4	6	0,3	0,4	0,394	6
W10	10	4	6	0,3	0,4	0,616	6
W12	12	5	8	0,3	0,6	0,888	6
W14	14	5	8	0,3	0,6	1,208	6
W16	16	5	8	0,2	0,6	1,578	6
W20	20	6	9	0,2	0,9	2,466	6
W25	25	6	9	0,2	0,9	3,853	6
W30	30	6	9	0,2	0,9	5,494	6
W35	35	7	11	0,2	1,5	7,552	6
W40	40	7	11	0,2	1,5	9,864	6
W50	50	7	11	0,2	1,5	15,413	6
W60	60	8	13	0,2	2,2	22,195	6
W80	80	8	13	0,2	2,2	39,458	6

Table 6.3 — Tolerances and dimensions of solid shafts made of Cf 53 with hard chrome coating

Type	Shaft diameter	Tolerance			Surface hardening depth	Weight	Max. shaft length
		Roundness	Diameter variation	Straightness			
	d [mm]	t1 [µm]	Δd·max [µm/1000mm]	t3 [µm]	SHD [mm]	[kg/m]	Lmax [mm]
W5	5	5	8	0,3	0,4	0,154	6 100
W6	6	5	8	0,3	0,4	0,222	6 100
W8	8	6	9	0,3	0,4	0,394	6 100
W10	10	6	9	0,3	0,4	0,616	6 100
W12	12	8	11	0,3	0,6	0,888	6 100
W14	14	8	11	0,3	0,6	1,208	6 100
W16	16	8	11	0,2	0,6	1,578	6 100
W20	20	9	13	0,2	0,9	2,466	6 100
W25	25	9	13	0,2	0,9	3,853	6 100
W30	30	9	13	0,2	0,9	5,494	6 100
W35	35	11	16	0,2	1,5	7,552	6 100
W40	40	11	16	0,2	1,5	9,864	6 100
W50	50	11	16	0,2	1,5	15,413	6 100
W60	60	1	19	0,2	2,2	22,195	6 100
W80	80	13	19	0,2	2,2	39,458	6 100
W80	80	8	13	0,2	2,2	39,458	6 100

Table 6.4 — Tolerances and dimensions of hollow shafts made of C60

Type	Shaft diameter	Inner diameter	Tolerance			Surface hardening depth	Weight	Max. shaft length
			Roundness	Diameter variation	Straightness			
	d [mm]	di [mm]	t1 [µm]	Δd·max [µm/1000mm]	t3 [µm]	SHD [mm]	[kg/m]	Lmax [mm]
HW12	12	4,0	8	8	0,3	0,6	0,790	6 100
HW16	16	7,0	8	8	0,3	0,6	1,280	6 100
HW20	20	14,0	9	9	0,3	0,9	1,250	6 100
HW25	25	15,6	9	9	0,3	0,9	2,350	6 100
HW30	30	18,3	9	9	0,3	0,9	3,500	6 000
HW40	40	28,0	11	11	0,3	1,5	4,990	6 000
HW50	50	29,7	11	11	0,2	1,5	9,910	6 000
HW60	60	36,0	13	13	0,2	2,2	14,200	6 000

Table 6.5 — Tolerances and dimensions of hollow shafts made of C60with hard chrome coating

Type	Shaft diameter	Inner diameter	Tolerance			Surface hardening depth	Weight	Max. shaft length
			Roundness	Diameter variation	Straightness			
	d [mm]	di [mm]	t1 [µm]	Δd·max [µm/1000mm]	t3 [µm]	SHD [mm]	[kg/m]	Lmax [mm]
HW16	16	7,0	8	8	0,3	0,6	1,280	6 100
HW20	20	14,0	9	9	0,3	0,9	1,250	6 100
HW25	25	15,6	9	9	0,3	0,9	2,350	6 100
HW30	30	18,3	9	9	0,3	0,9	3,500	6 000
HW40	40	28,0	11	11	0,3	1,5	4,990	6 000
HW50	50	29,7	11	11	0,2	1,5	9,910	6 000

6.1.3 Shaft machining

Shafts that are cut to length are manufactured with length tolerances from Table 6.6.

Table 6.6 — Length tolerances from shafts

Shaft length		Max. length tolerance
L [mm]		
from	up to	[mm]
	≤ 400	± 0,5
> 400	≤ 1 000	± 0,8
> 1 000	≤ 2 000	± 1,2
> 2 000	≤ 4 000	± 2,0
> 4 000		± 3,0

Shafts can be manufactured with standard machining or with machining according to customer drawings. The machining's are coded using the indexes in Table 6.7.

Table 6.7 — Indexes for shaft machining

Index	Discription	Dimension
00	Standard, cross cut shaft end deburred	
01	Shaft end with champfer	Table 6.8
02	Front end with axial thread	Table 6.9
03	Front end with axial thread and centering hole according to DIN 332-2	Table 6.10
04	Radial thread for mounting on shaft supports	Table 6.11
XX	Machining according customer drawing	

Index 01

Shaft ends with a chamfer are manufactured in accordance with Figure 6.2 and the dimensions in Table 6.8.

Table 6.8 — Dimension from shaft ends with chamfer

d		L1
[mm]		[mm]
from	up to	
	≤ 4	$1{,}0^{+0{,}5}$
5	≤ 10	$1{,}5^{+1{,}0}$
12	≤ 35	$2{,}0^{+1{,}0}$
> 40		$3{,}0^{+1{,}0}$

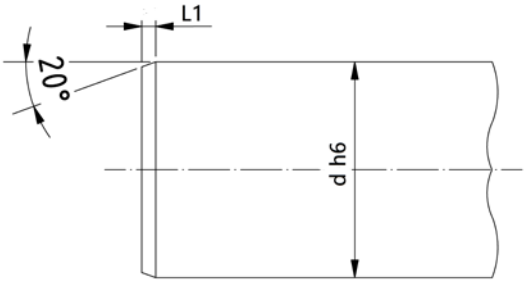


Figure 6.2 — Shaft ends with chamfer

Index 02

Shaft ends with axial threads are manufactured according to Figure 6.3 with the dimensions specified in Table 6.9. The chamfer corresponds to the specification of Index 01.

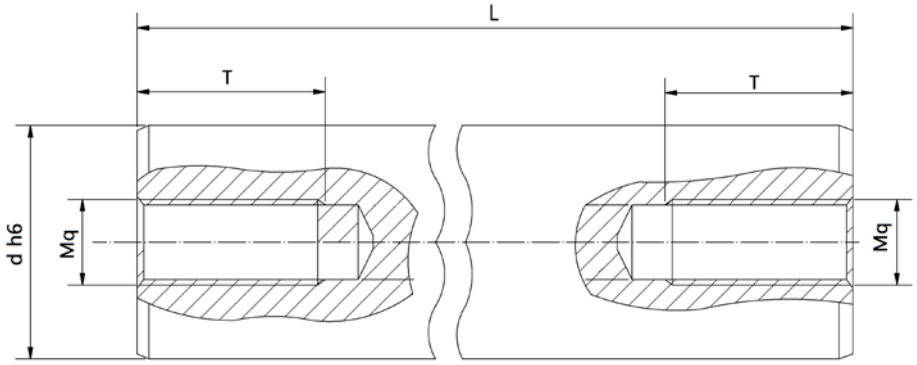


Figure 6.3 — Shaft ends with axial thread

Table 6.9 — Dimension from shaft ends with axial thread

d	Mq	T
[mm]		[mm]
12	M5	12,5
16	M6	16,0
20	M8	19,0
25	M10	22,0
30	M12	28,0
40	M12	28,0
50	M16	36,0

Index 03

Shaft ends with axial thread and centering bore according to DIN 332-2 are manufactured according to Figure 6.4 with the dimensions in Table 6.10. The chamfer corresponds to the specification of Index 01.

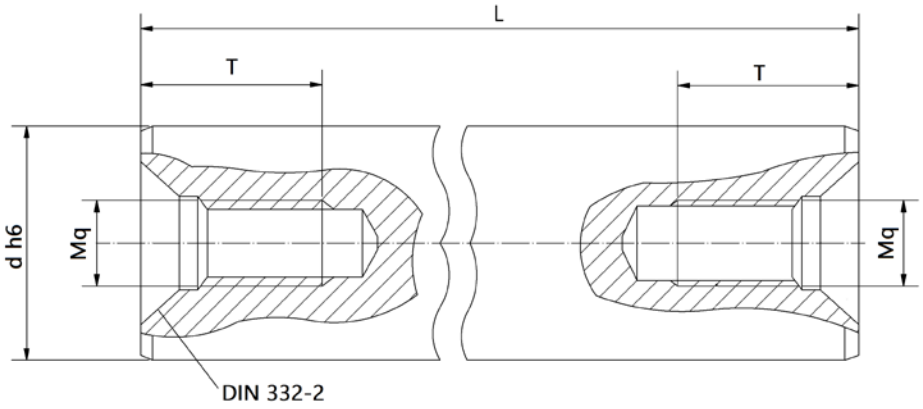


Figure 6.4 — Shaft ends with axial thread and centering bore

Table 6.10 — Dimension from shaft ends with axial thread and centering bore

d	Mq	T
[mm]		[mm]
12	M5	12,5
16	M6	16,0
20	M8	19,0
25	M10	22,0
30	M12	28,0
40	M12	28,0
50	M16	36,0

Index 04

Shafts with radial threads for mounting on shaft supports are manufactured according to Figure 6.5 with the dimensions in Table 6.11. The chamfer corresponds to the specification of Index 01

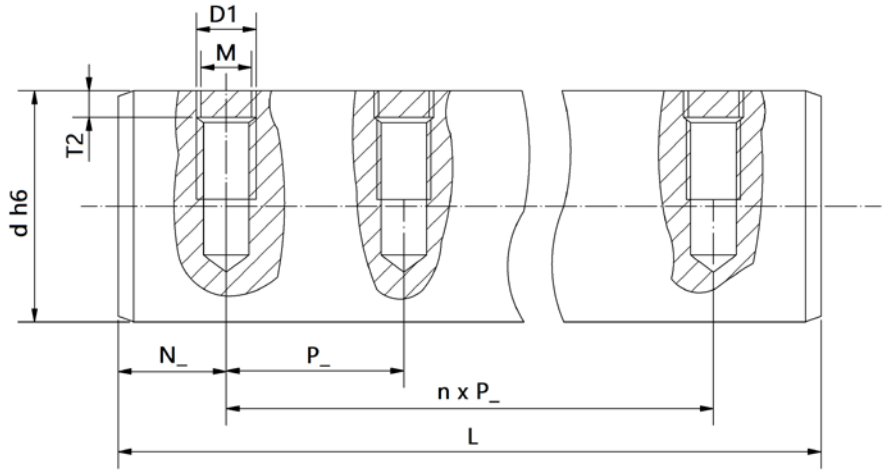


Figure 6.5 — Shafts with radial threads for mounting on shaft supports

Table 6.11 — Dimension from shafts with radial threads for mounting on shaft supports

d	M	D1	T2	SR10		SR20				SR30		SR40	
				N0	P0	N1	P1	N2	P2	N3	P3	N4	P4
[mm]		[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]
12	M4	5	2,5	37,5	75	37,5	75	60	120	-	-	-	-
16	M5	6	2,5	37,5	75	50,0	100	75	150	-	-	-	-
20	M6	7	3,0	37,5	75	50,0	100	75	150	25,0	50	18,75	37,5
25	M8	9	3,0	37,5	75	60,0	120	100	200	30,0	60	18,75	37,5
30	M10	11	3,5	50,0	100	75,0	150	100	200	27,5	75	25,00	50,0
40	M10	11	4,0	50,0	100	100,0	200	150	300	50,0	100	25,00	50,0
50	M12	13	4,0	50,0	100	100,0	200	150	300	50,0	100	25,00	50,0

6.2 Support rails

When using open ball bushings and open linear units, the shafts can be mounted on support rails. Different designs are available depending on the surrounding structure. The dimensions of the different designs are shown in Figures 6.6 to 6.9 and summarized in Tables 6.12 to 6.15. The support rails can be used continuously or only partially to support the shafts.

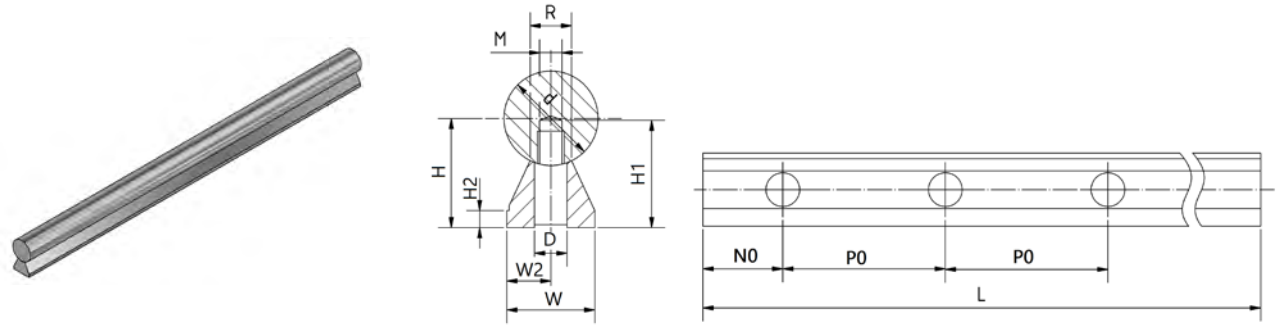


Figure 6.6 — Support rails for screwing from below

Table 6.12 — Dimension from support rails for screwing from below

	d	H ±0,02	H1	W ±0,02	W2 ±0,02	H2	M	D	R	N0	P0	L_{max}	Weight[1]
	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]		[mm]	[mm]	[mm]	[mm]	[mm]	[kg/l]
SR10-12	12	14,5	15,5	11	5,5	3	M4	4,5	5,4	37,5	75	4 000	0,21
SR10-16	16	18,0	16,0	14	7,0	3	M5	5,5	7,0	37,5	75	4 000	0,31
SR10-20	20	22,0	20,0	17	8,5	3	M6	6,6	8,1	37,5	75	4 000	0,45
SR10-25	25	26,0	25,0	21	10,5	3	M8	9,0	10,3	37,5	75	4 000	0,59
SR10-30	30	30,0	30,0	23	11,5	3	M10	11,0	11,0	50,0	100	4 000	0,74
SR10-40	40	39,0	38,0	30	15,0	4	M12	13,5	15,0	50,0	100	4 000	1,26
SR10-50	50	46,0	45,0	35	17,5	5	M14	15,5	19,0	50,0	100	2 400	4,90

[1] without shaft

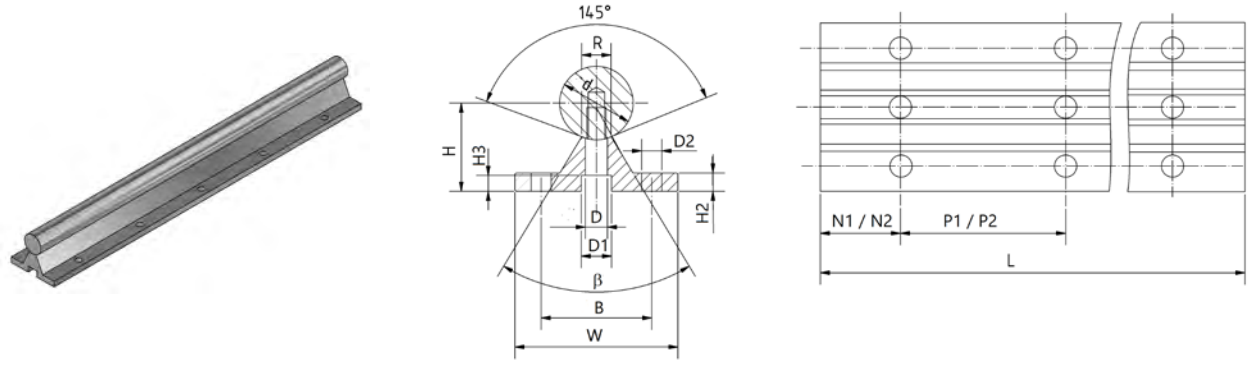


Figure 6.7 — Support rails in flange design

Table 6.13 — Dimension from support rails in flange design

	d	H ±0,02	W	B ±0,15	H2	H3	D	D1	D2	R -0,3	b	N1[1]	P1[1]	N2[2]	P2[2]	L_{max}	Weight[3]
	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[°]	[mm]	[mm]	[mm]	[mm]	[mm]	[kg/m]
SR20-12	12	22	40	29	5	5,0	4,5	8,0	4,5	5,8	50	37,5	75	60,0	120	4 250	0,75
SR20-16	16	26	45	33	5	6,0	5,5	9,5	5,5	7,0	50	50,0	100	75,0	150	4 250	0,92
SR20-20	20	32	52	37	6	6,5	6,6	11,0	6,6	8,3	50	50,0	100	75,0	150	4 250	1,33
SR20-25	25	36	57	42	6	8,5	9,0	14,0	6,6	10,8	50	60,0	120	100,0	200	4 250	1,52
SR20-30	30	42	69	51	7	10,5	11,0	17,0	9,0	11,0	50	75,0	150	100,0	200	4 250	1,92
SR20-40	40	50	73	55	8	10,5	11,0	17,0	9,0	15,0	50	100,0	200	150,0	300	4 250	2,64
SR20-50	50	60	84	63	9	12,5	13,0	19,0	11,0	19,0	40	100,0	200	150,0	300	4 250	3,55

[1] for high dimensional accuracy requirements and transverse loads on the ball bushing opening
[2] for general requirements
[3] without shaft

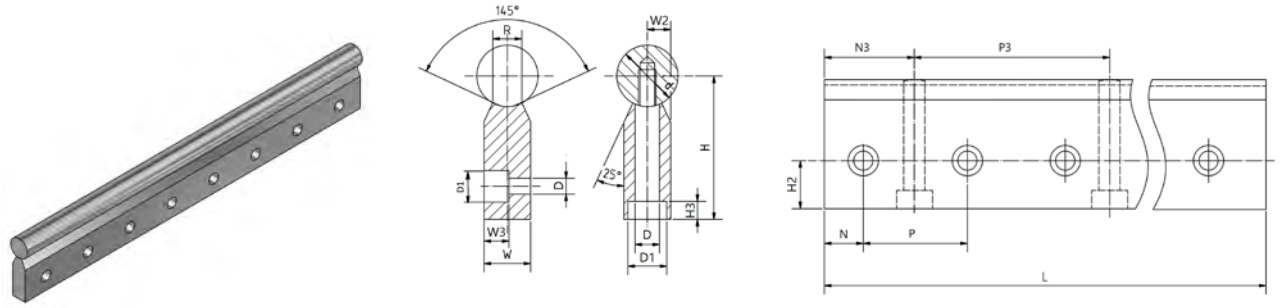


Figure 6.8 — Support rails for lateral mounting with one row of bore holes

Table 6.14 — Dimension from support rails for lateral mounting with one row of bore holes

	d	H	W	W2	W3	H2	H3	D	D1	R	N	P	N3	P3	L_{max}	Weight[1] L_{max}
	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[kg]
SR30-20	20	52	15	7,5	8,5	15	8,5	6,6	11,0	8,3	25,0	50	50	100	600	0,85
SR30-25	25	62	20	10,0	11,0	18	15,0	9,0	15,0	10,8	30,0	60	60	120	600	1,35
SR30-30	30	72	25	12,5	13,5	21	15,3	11,0	18,0	11,0	27,5	75	75	150	600	1,85
SR30-40	40	88	30	15,0	16,0	25	19,0	11,0	18,0	15,0	50,0	100	100	200	600	2,65
SR30-50	50	105	35	17,5	18,5	30	21,5	14,0	20,0	19,0	50,0	100	100	200	600	3,55

1 without shaft

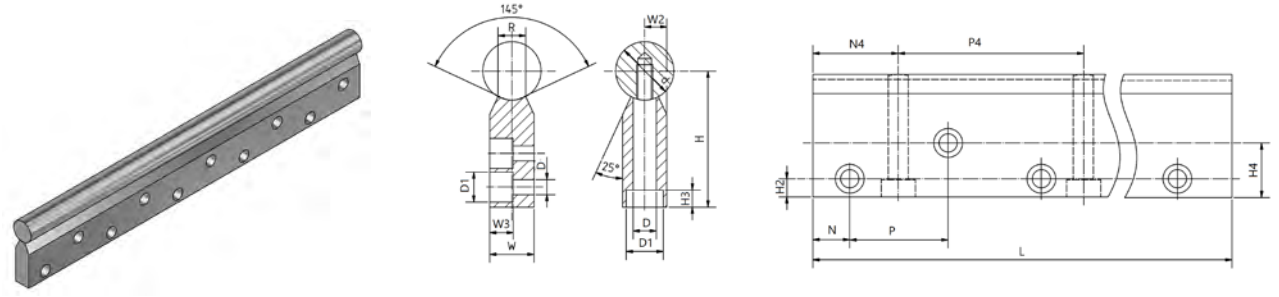


Figure 6.9 — Support rails for lateral mounting with double row of bore holes

Table 6.15 — Dimensions from support rails for lateral mounting with double row of bore holes

	d	H	W	W2	W3	H2	H3	H4	D	D1	R	N	P	N4	P4	L_{max}	Weight[1] L_{max}
	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[kg]
SR40-20	20	52	15	7,5	8,5	8	8,5	22	6,6	11,0	8,3	18,75	37,5	37,5	75	600	0,85
SR40-25	25	62	20	10,0	11,0	10	15,0	26	9,0	15,0	10,8	18,75	37,5	37,5	75	600	1,35
SR40-30	30	72	25	12,5	13,5	12	15,3	30	11,0	18,0	11,0	25,00	50,0	50,0	100	600	1,85
SR40-40	40	88	30	15,0	16,0	12	19,0	38	14,0	20,0	15,0	25,00	50,0	50,0	100	600	2,65
SR40-50	50	105	35	17,5	18,5	15	21,5	45	16,0	24,0	19,0	25,00	50,0	50,0	100	600	3,55

[1] without shaft

6.3 Shaft supports

Shaft supports can be used to mount cantilevered shafts. The dimensions are shown in Figure 6.10 and Table 6.16.

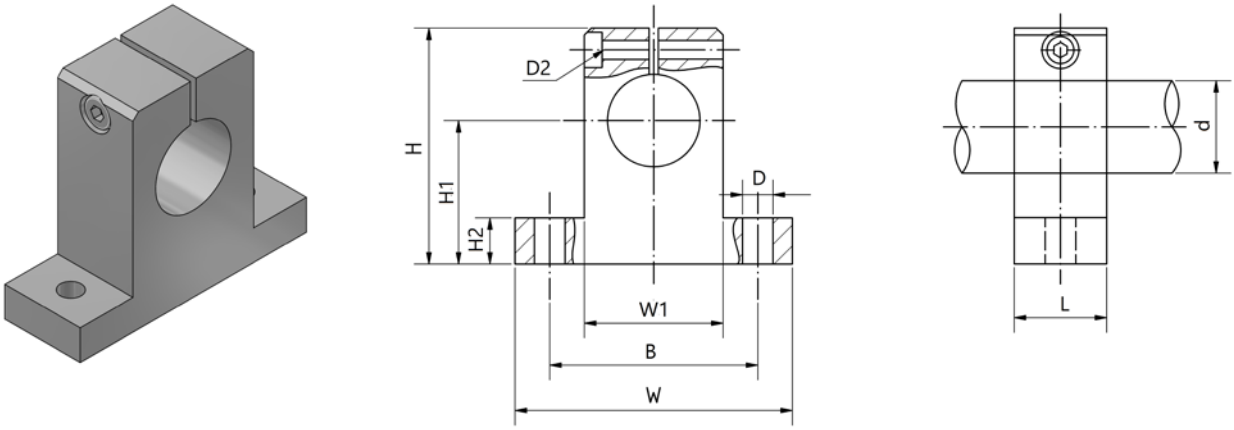


Figure 6.10 — Shaft supports

Table 6.16 — Dimension from shaft supports

	d H8	H	H1 ±0,02	W	B ±0,15	W1	L	H2	D	D2	Weight
	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[kg]
SK8	8	27	15	32	25,0	16	10	5,0	4,5	3	0,01
SK12	12	35	20	42	32,0	20	12	5,5	5,5	3	0,02
SK16	16	42	25	50	40,0	26	16	6,5	5,5	3	0,03
SK20	20	50	30	60	45,0	32	20	8,0	5,5	4	0,07
SK25	25	58	35	74	60,0	38	25	9,0	6,6	5	0,14
SK30	30	68	40	84	68,0	45	28	10,0	9,0	6	0,20
SK40	40	86	50	108	86,0	56	32	12,0	11,0	8	0,48
SK50	50	100	60	130	108,0	80	40	14,0	11,0	8	1,90
SK60	60	124	75	160	132,0	100	48	15,0	13,5	8	3,60

6.4 Traverses

Traverses can be used to mount parallel shafts. The shaft spacing corresponds to that of the Quattro linear units (Chapters 5.4.11 and 5.4.12).

The traversen are available in two versions. When using version A, the traverses are firmly screwed in position and the quattro linear unit moves on the shafts. In version B, the Quattro linear unit is firmly screwed in position and the shafts move through the linear unit. The dimensions are shown in Figure 6.11 and Tables 6.17 and 6.18.

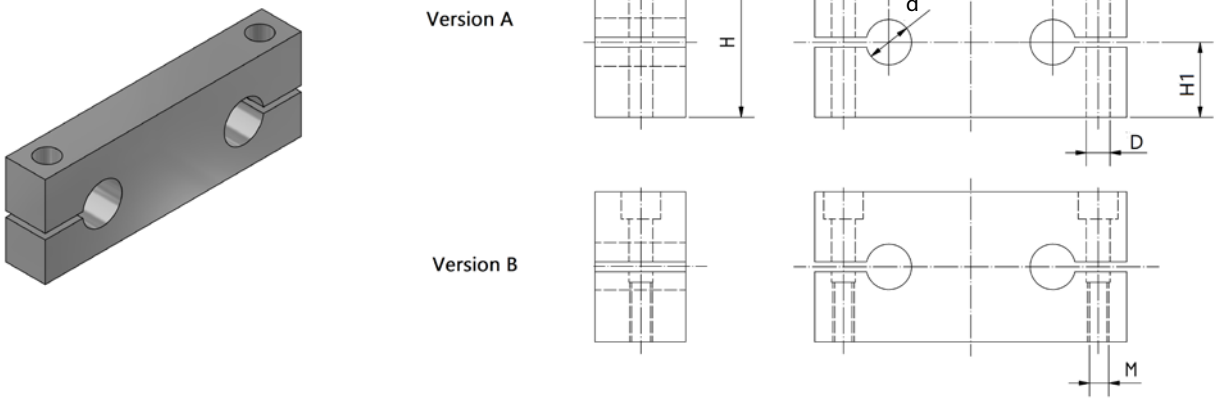


Figure 6.11 — Traverses

Table 6.17 — Dimension from traverses Version A

	d	W	L	H	H1 ±0,015	B	D	M	W2	Weight
	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]		[mm]	[kg]
SH8A	8	65	12	23	12,5	52	5,5	-	32	0,04
SH12A	12	85	14	32	18,0	70	6,6	-	42	0,07
SH16A	16	100	18	36	20,0	82	9,0	-	54	0,13
SH20A	20	130	20	46	25,0	108	11,0	-	72	0,22
SH25A	25	160	25	56	30,0	132	13,5	-	88	0,44
SH30A	30	180	25	64	35,0	150	13,5	-	96	0,56
SH40A	40	230	30	80	44,0	190	17,5	-	122	1,00

Table 6.18 — Dimension from traverses Version B

	d	W	L	H	H1 ±0,015	B	D	M	W2	Weight
	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]		[mm]	[g]
SH8B	8	65	12	22	11	52	-	M5	32	0,04
SH12B	12	85	14	28	14	70	-	M6	42	0,07
SH16B	16	100	18	32	16	82	-	M8	54	0,13
SH20B	20	130	20	42	21	108	-	M10	72	0,22
SH25B	25	160	25	52	26	132	-	M12	88	0,44
SH30B	30	180	25	58	29	150	-	M12	96	0,56
SH40B	40	230	30	72	36	190	-	M16	122	1,00

6.5 Clamping elements

Clamping elements for SNR ball bushings allow the positioning and holding in different application areas.

6.5.1 Manual clamping elements

Manual clamping elements are designed for up to 50,000 static clamping cycles.
The manual clamping elements for ball bushings are actuated via a freely adjustable hand lever. In the process, the clamping jaws press synchronously against the shafts. The floating clamping jaws guarantee symmetrical force transmission to the shafts. The dimensions are shown in Figure 6.12 and summarized in Table 6.19.

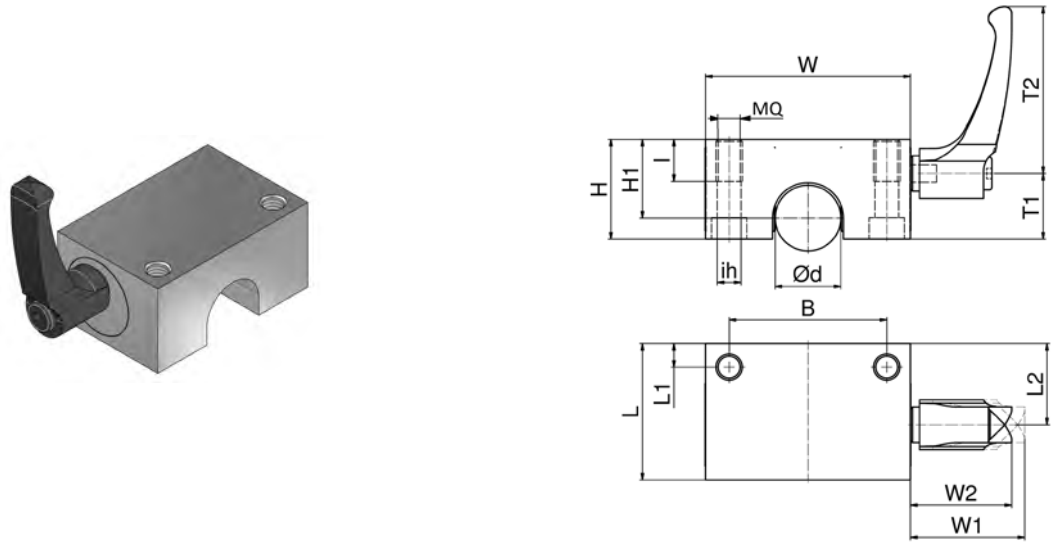


Figure 6.12 — Manual clamping elements for ball bushings

Table 6.19 — Dimension from manual clamping elements for ball bushings

Type	d	Holding force	Holding moment	W	L	H	H1	B	L1	MQ	l	ih	W1	W2	L2	T1	T2	Weight
	[mm]	[N]	[Nm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]		[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[kg]
HKR1200A	12	1 200	7	43	32	24	18	32	4,5	M5	10	4,4	33,5	30,5	18,5	16,0	44	0,23
HKR1600A	16	1 200	10	53	38	29	22	40	5,5	M6	12	5,0	33,5	30,5	22,0	19,0	44	0,40
HKR2000A	20	1 200	12	60	44	32	25	45	6,5	M8	14	6,8	41,5	38,5	26,0	21,5	63	0,55
HKR2500A	25	1 200	15	78	52	38	30	60	9,0	M10	16	8,6	41,5	38,5	31,0	25,0	63	1,00
HKR3000A	30	2 000	30	87	58	43	35	68	10,0	M10	16	8,6	50,5	46,5	35,0	28,5	78	1,50
HKR4000A	40	2 000	40	108	68	53	45	86	11,0	M12	20	10,5	61,5	56,5	40,5	34,5	95	2,10
HKR5000A	50	2 000	50	132	76	58	50	108	12,0	M16	22	14,5	61,5	56,5	46,0	39,5	95	2,30
HKR6000A	60	2 000	60	157	76	68	60	132	12,0	M16	22	14,5	61,5	56,5	46,0	45,0	95	3,60

6.5.2 Pneumatic clamping elements

Pneumatic clamping elements are designed for up to 5 million static clamping cycles.
Pneumatic clamping elements are available in different designs as active (NO) and passive (NC) variants.
Active variants are elements that close with pneumatic pressure, while passive variants close with spring energy storage.
An integrated wedge gear realizes high holding forces. The pressure medium moves the wedge gear in the longitudinal direction. The resulting transverse movement presses the clamping jaws against the shafts with high force. The dimensions of active elements are summarized in Figure 6.13 and Table 6.20, the passive elements in Figures 6.14 and Table 6.21.

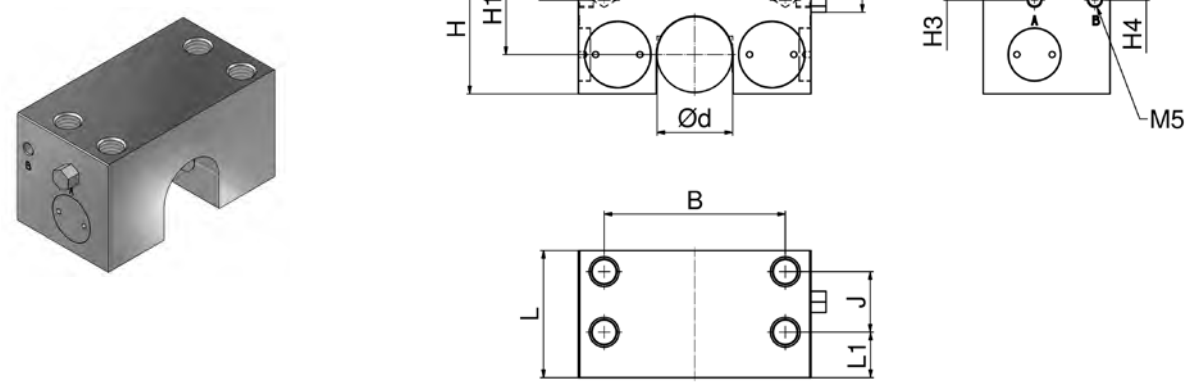


Figure 6.13 — Active pneumatic clamping elements for ball bushings

Table 6.20 — Dimension from active pneumatic clamping elements (NO) for ball bushings

Type	d	Holding force	Nominal operating pressure	W	L	H	H1	B	J	L1	MQ	I	W1	L2	L3	H3	H4	Weight
	[mm]	[N]	[bar]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]		[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[kg]
MKR1000A	10	650	6	50	37,0	27,5	16	15	15	11,0	M5	6	5	5	32,0	6,7	6,7	0,26
MKR1200A	12	650	6	50	37,0	27,5	18	15	15	11,0	M5	6	5	5	32,0	6,7	6,7	0,28
MKR1600A-A	16	650	6	55	39,0	22,0	22	15	15	11,0	M5	6	5	5	32,0	10,0	10,0	0,35
MKR2000A	20	1 000	6	66	38,0	38,0	25	45	18	13,0	M8	10	5	5	22,0	10,0	10,0	0,49
MKR2500A	25	1 200	6	77	42,0	43,0	30	60	20	15,0	M10	12	5	5	25,0	12,0	12,0	0,72
MKR3000A	30	1 700	6	92	48,5	48,5	35	68	25	14,0	M10	13	5	5	30,0	12,0	12,0	1,20
MKR4000A	40	1 850	6	120	49,0	62,0	45	90	26	14,0	M10	15	5	5	30,0	15,0	15,0	2,30
MKR5000A	50	1 850	6	132	49,0	67,0	50	108	30	9,5	M10	15	5	19,5	29,5	17,0	17,0	2,50
MKR6000A	60	1 850	6	142	49,0	67,0	50	108	30	9,5	M10	15	5	19,5	29,5	14,0	14,0	2,50

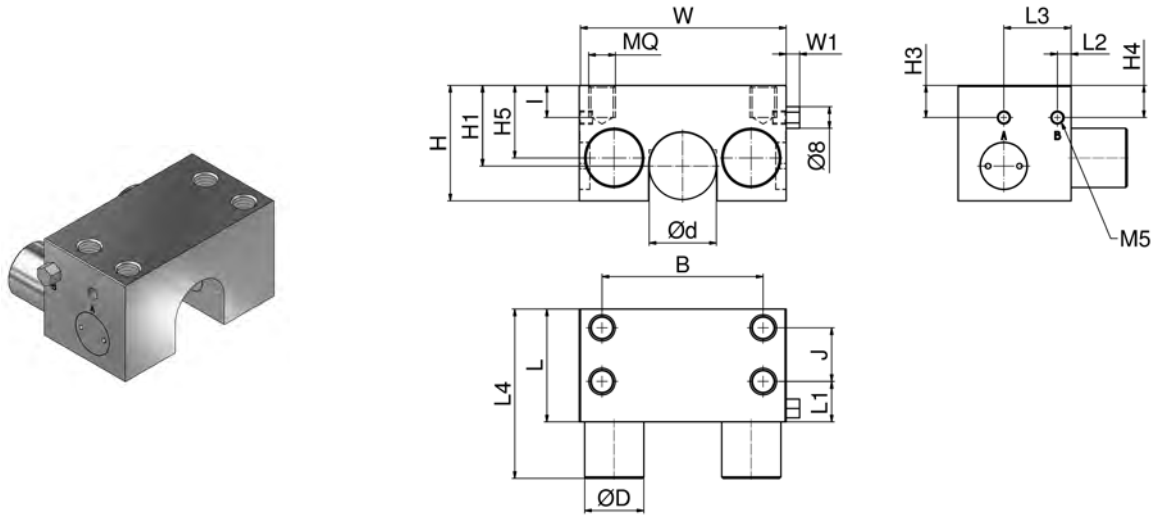


Figure 6.14 — Passive pneumatic clamping elements for ball bushings

Table 6.21 — Dimension from passive pneumatic clamping elements (NC) for ball bushings

Type	d	Holding force	Nominal operating pressure	W	L	L4	H	H1	B	J	L1	MQ	I	W1	L2	L3	H3	H4	D	H5	Weight
	[mm]	[N]	[bar]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]		[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[kg]
MKRS1000A	10	350	6	50	37,0	56,0	27,5	16	15	15	11,0	M5	6	5	5	32,0	6,7	6,7	16,0	18,0	0,30
MKRS1200A	12	350	6	50	37,0	56,0	27,5	18	15	15	11,0	M5	6	5	5	32,0	6,7	6,7	16,0	18,0	0,30
MKRS1600A-A	16	400	6	55	39,0	56,0	22,0	22	15	15	11,0	M5	6	5	5	32,0	10,0	10,0	16,0	19,0	0,38
MKRS2000A	20	600	6	66	38,0	60,0	38,0	25	45	18	13,0	M8	10	5	5	22,0	10,0	10,0	20,0	25,0	0,53
MKRS2500A	25	750	6	77	42,0	63,0	43,0	30	60	20	15,0	M10	12	5	5	25,0	12,0	12,0	22,0	30,0	0,78
MKRS3000A	30	1 050	6	92	48,5	77,5	48,5	35	68	25	14,0	M10	13	5	5	30,0	12,0	12,0	25,0	34,0	1,30
MKRS4000A	40	1 650	6	120	49,0	82,0	62,0	45	90	26	14,0	M10	15	5	5	30,0	15,0	15,0	30,0	45,0	2,50
MKRS5000A	50	1 650	6	132	49,0	82,0	67,0	50	108	30	9,5	M10	15	5	19,5	29,5	17,0	17,0	30,0	50,0	2,60
MKRS6000A	60	1 650	6	142	49,0	82,0	67,0	50	108	30	9,5	M10	15	5	19,5	29,5	14,0	14,0	30,0	50,0	2,70

7 Type codes

Ball bushing

BB	E	R	S	20	L	A	UU	_	OP	_	RL
1	2	3	4	5	6	7	8		9		10

1	BBC	**Product** **BB:** Ball Bushing
2	E	**Series** **without:** JIS series **E:** ISO series
3	R	**Design version** **without:** Standard ball bushing **R:** Flange type ball bushing **RM:** Middle flange type ball bushing **T:** Super ball bushing with self-alignment **W:** Super ball bushing without self-alignment
4	S	**Material outer cylinder** **without:** Roller bearing steel **S:** Stainless steel
5	20	**Shaft diameter [mm]**
6	L	**Design length** **without:** Standard length **L:** Tandem version
7	A	**Cage material** **without:** Plastic **A:** Alloy steel or stainless steel
8	UU	**Sealing options** **without:** without seals **UU:** Lip seals on both sides (Standard version) **U:** Lip seal on one side
9	OP	**Design type** **without:** closed **AJ:** adjustable **OP:** open
10	RL	**Special version** **without:** Standard **RL:** re-lubricable

Ball sleeves

KH	12	28	LL/AS
1	2	3	4

1	KH	**Product** **KH:** Ball sleeve
2	12	**Shaft diameter [mm]**
3	28	**Design length [mm]**
4	LL/3AS	**Sealing options** **without:** without seals **LL/3AS:** Lip seals on both sides (Standard version)

Linear units

LS	E	T	20	L	UU	_	OP
1	2	3	4	5	6		7

1	LS	**Product** **LS:** Linear unit
2	E	**Series** **E:** ISO series
3	T	**Design version** **without:** with standard ball bushings **T:** with super ball bushing with self-alignment
4	20	**Shaft diameter [mm]**
5	L	**Design length** **without:** Standard length **L:** Tandem version **Q:** Quattro version
6	UU	**Sealing options** **UU:** Lip seals on both sides
7	OP	**Design type** **without:** closed **AJ:** closed adjustable **AO:** open adjustable **OP:** open **SAO:** lateral open adjustable **SOP:** lateral open

Shafts

W	20	_	1000	_	0	_	04	_	04	_	N1	_	P1
1	2		3		4		5		6		7		8

1	**W**	**Product** **W:** Solid shaft **HW:** Hollow shaft
2	**20**	**Shaft diameter [mm]**
3	**1000**	**Shaft length [mm]**
4	**0**	**Material** **0:** Cf53 for solid shaft, C60 for hollow shaft **1:** X90CrMoV18 **2:** Cf53 for solid shaft with hard chrome coating, C60 for hollow shaft with hard chrome coating **3:** X46Cr13
5	**04**	**Index for shaft machining** (one shaft end) see Chapter 6.1.3,Table 6.7 — Indexes for shaft machining (specify index 04 on both sides)
6	**04**	**Index for shaft machining** (second shaft end) see Chapter 6.1.3,Table 6.7 — Indexes for shaft machining (specify index 04 on both sides)
7	**N1**	**Starting value** **N0:** Standard value for SR10 **N1, N2:** Standard values for SR20 **N3:** Standard value for SR30 **N4:** Standard value for SR40 **N_:** Special value [mm]
8	**P1**	**Thread distance** **P0:** Standard value for SR10 **P1, P2:** Standard values for SR20 **P3:** Standard value for SR30 **P4:** Standard value for SR40 **P_:** Special value [mm]

Support rails

SR	20	_	16	_	1000	_	N1	_	P1	_	W	_	0	_	04	_	04
1	2		3		4		5		6		7		8		9		10

1	**SR**	**Product** **SR:** Support rail
2	**20**	**Size**
3	**16**	**Shaft diameter [mm]**
4	**1000**	**Support rail length [mm]**
5	**N1**	**Starting value** **N0:** Standard value for SR10 **N1, N2:** Standard values for SR20 **N3:** Standard value for SR30 **N4:** Standard value for SR40 **N_:** Special value [mm]
6	**P1**	**Thread distance** **P0:** Standard value for SR10 **P1, P2:** Standard values for SR20 **P3:** Standard value for SR30 **P4:** Standard value for SR40
7	**W**	**Version** **without:** without shaft **W:** with mounted shaft (shaft must be ordered separately)
8	**0**	**Material from the shaft** **0:** Cf53 **1:** X90CrMoV18 **2:** Cf53 with hard chrome coating **3:** X46Cr13
9*	**04**	**Index for shaft machining** (one shaft end) see Chapter 6.1.3,Table 6.7 — Indexes for shaft machining (specify index 04 on both sides)
10*	**04**	**Index for shaft machining** (second shaft end) see Chapter 6.1.3 ,Table 6.7 — Indexes for shaft machining (specify index 04 on both sides)

* Points 8 to 10 do not apply if configuration is carried out without shaft

8 Type list

Type	Description	Page
BB_	Standard ball bushings, closed, JIS dimension	27
BBE_	Standard ball bushings, closed, ISO dimension	26
BBE_-AJ	Standard ball bushings, adjusable, ISO dimension	30
BBE_L	Tandem ball bushings, closed, ISO dimension	28
BBE_-OP	Standard ball bushings, open, ISO dimension	29
BBER_	Standard flange type ball bushings, ISO dimension	31
BBER_L	Tandem flange type ball bushings, ISO dimension	32
BBERM_	Middle flange type ball bushings, ISO dimension	33
BBET_	Super ball bushings with self-alignment, closed, ISO dimension	34
BBET_-OP	Super ball bushings with self-alignment, open, ISO dimension	35
BBEW_	Super ball bushings without self-alignment, closed, ISO dimension	36
BBEW_-OP	Super ball bushings without self-alignment, open, ISO dimension	37
HKR_	manual clamping element	65
HW_	Hollow shaft	58
KH_	Ball sleeves, ISO dimension	38
LSE_	Linear unit with Standard ball bushings, closed	39
LSE_-AJ	Linear unit with Standard ball bushings, closed, radial clearance adjusable	41
LSE_-AO	Linear unit with Standard ball bushings, open, radial clearance adjusable	45
LSE_L	Tandem linear unit with Standard ball bushings, closed	40
LSE_L-AJ	Tandem linear unit with Standard ball bushings, closed, radial clearance adjusable	42
LSE_L-AO	Tandem linear unit with Standard ball bushings, open, radial clearance adjusable	46
LSE_L-OP	Tandem linear unit with Standard ball bushings, open	44
LSE_-OP	Linear unit with Standard ball bushings, open	43
LSE_Q	Quattro linear unit with Standard ball bushings LSE_Q, closed	49
LSE_Q-OP	Quattro linear unit with Standard ball bushings LSE_Q, open	50
LSE_-SAO	Linear unit with Standard ball bushings, lateral open, radial clearance adjusable	48
LSE_-SOP	Linear unit with Standard ball bushings, lateral open	47
LSET_	Linear unit with Super ball bushings, closed	51
LSET_-AO	Linear unit with Super ball bushings, open, radial clearance adjusable	55
LSET_L	Tandem linear unit with Super ball bushings, closed	53
LSET_L-AO	Tandem linear unit with Super ball bushings, open, radial clearance adjusable	56
LSET_L-OP	Tandem linear unit with Super ball bushings, open	54
LSET_-OP	Linear unit with Super ball bushings, open	53
MKR_	active pneumatic clamping element	66
MKRS_	passive pneumatic clamping element	67
SH_A	Traverse version A	64
SH_B	Traverse version B	64
SK_	Shaft support	63
SR_	Support rail	61, 62
W_	Solid shaft	58

9. Fits

Shaft tolerance [µm]

over	up to	d9	e8	f7	f6	f5	g6	g5	h5	h6	h7	h8	h9	h10
-	3	-20	-14	-6	-6	-6	-2	-2	0	0	0	0	0	0
		-45	-28	-16	-12	-10	-8	-6	-4	-6	-10	-14	-25	-40
3	6	-30	-20	-10	-10	-10	-4	-4	0	0	0	0	0	0
		-60	-38	-22	-18	-15	-12	-9	-5	-8	-12	-18	-30	-48
6	10	-40	-25	-13	-13	-13	-5	-5	0	0	0	0	0	0
		-76	-47	-28	-22	-19	-14	-11	-6	-9	-15	-22	-36	-58
10	18	-50	-32	-16	-16	-16	-6	-6	0	0	0	0	0	0
		-93	-59	-34	-27	-24	-17	-14	-8	-11	-18	-27	-43	-70
18	30	-65	-40	-20	-20	-20	-7	-7	0	0	0	0	0	0
		-117	-73	-41	-33	-29	-20	-16	-9	-13	-21	-33	-52	-84
30	50	-80	-50	-25	-25	-25	-9	-9	0	0	0	0	0	0
		-142	-89	-50	-41	-36	-25	-20	-11	-16	-25	-39	-62	-100
50	80	-100	-60	-30	-30	-30	-10	-10	0	0	0	0	0	0
		-174	-106	-60	-49	-43	-29	-23	-13	-19	-30	-46	-74	-120
80	120	-120	-72	-36	-36	-36	-12	-12	0	0	0	0	0	0
		-207	-126	-71	-58	-51	-34	-27	-15	-22	-35	-54	-87	-140
120	180	-145	-85	-43	-43	-43	-14	-14	0	0	0	0	0	0
		-245	-148	-83	-68	-61	-39	-32	-18	-25	-40	-63	-100	-160
180	250	-170	-100	-50	-50	-50	-15	-15	0	0	0	0	0	0
		-285	-172	-96	-79	-70	-44	-35	-20	-29	-46	-72	-115	-185
250	315	-190	-110	-56	-56	-56	-17	-17	0	0	0	0	0	0
		-320	-191	-108	-88	-79	-49	-40	-23	-32	-52	-81	-130	-210
315	400	-210	-125	-62	-62	-62	-18	-18	0	0	0	0	0	0
		-350	-214	-119	-98	-87	-54	-43	-25	-36	-57	-89	-140	-230

Bore tolerance [µm]

over	up to	D10	E9	F6	F7	F8	G6	G7	H5	H6	H7	H8	H9	H10
-	3	+60	+39	+12	+16	+20	+8	+12	+4	+6	+10	+14	+25	+40
		+20	+14	+6	+6	+10	+2	+2	0	0	0	0	0	0
3	6	+78	+50	+18	+22	+28	+12	+16	+5	+8	+12	+18	+30	+48
		+30	+20	+10	+10	+10	+4	+4	0	0	0	0	0	0
6	10	+98	+61	+22	+28	+35	+14	+20	+6	+9	+15	+22	+36	+58
		+40	+25	+13	+13	+13	+5	+5	0	0	0	0	0	0
10	18	+120	+75	+27	+34	+43	+17	+24	+8	+11	+18	+27	+43	+70
		+50	+32	+16	+16	+16	+6	+6	0	0	0	0	0	0
18	30	+149	+92	+33	+41	+53	+20	+28	+9	+13	+21	+33	+52	+84
		+65	+40	+20	+20	+20	+7	+7	0	0	0	0	0	0
30	50	+180	+112	+41	+50	+64	+25	+34	+11	+16	+25	+39	+62	+100
		+80	+50	+25	+25	+25	+9	+9	0	0	0	0	0	0
50	80	+220	+134	+49	+60	+76	+29	+40	+13	+19	+30	+46	+74	+120
		+100	+60	+30	+30	+30	+10	+10	0	0	0	0	0	0
80	120	+260	+159	+58	+71	+90	+34	+47	+15	+22	+35	+54	+87	+140
		+120	+72	+36	+36	+36	+12	+12	0	0	0	0	0	0
120	180	+305	+185	+68	+83	+106	+39	+54	+18	+25	+40	+63	+100	+160
		+145	+85	+43	+43	+43	+14	+14	0	0	0	0	0	0
180	250	+335	+215	+79	+96	+122	+44	+61	+20	+29	+46	+72	+115	+185
		+170	+110	+50	+50	+50	+15	+15	0	0	0	0	0	0
250	315	+400	+240	+88	+108	+137	+49	+69	+23	+32	+52	+81	+130	+210
		+190	+110	+56	+56	+56	+17	+17	0	0	0	0	0	0
315	400	+440	+265	+98	+119	+151	+54	+75	+25	+36	+57	+89	+140	+230
		+210	+125	+62	+62	+62	+18	+18	0	0	0	0	0	0

h11	js5	js6	j5	j6	k5	k6	m5	m6	n5	n6	p6	p5	over	up to
0	+2	+3	+2	+4	+4	+6	+6	+8	+8	+10	+12	+10	-	3
-60	-2	-3	-2	-2	0	0	+2	+2	+4	+4	+6	+6		
0	+ 2.5	+4	+3	+6	+6	+9	+9	+12	+13	+16	+20	+17	3	6
-75	- 2.5	-4	-2	-2	+1	+1	+4	+4	+8	+8	+12	+12		
0	+3	+ 4.5	+4	+7	+7	+10	+12	+15	+16	+19	+24	+21	6	10
-90	-3	- 4.5	-2	-2	+1	+1	+6	+6	+10	+10	+15	+15		
0	+4	+ 5.5	+5	+8	+9	+12	+15	+18	+20	+23	+29	+26	10	18
-110	-4	- 5.5	-3	-3	+1	+1	+7	+7	+12	+12	+18	+18		
0	+ 4.5	+ 6.5	+5	+9	+11	+15	+17	+21	+24	+28	+35	+31	18	30
-130	- 4.5	- 6.5	-4	-4	+2	+2	+8	+8	+15	+15	+22	+22		
0	+ 5.5	+8	+6	+11	+13	+18	+20	+25	+28	+33	+42	+37	30	50
-160	- 5.5	-8	-5	-5	+2	+2	+9	+9	+17	+17	+26	+26		
0	+ 6.5	+ 9.5	+6	+12	+15	+21	+24	+30	+33	+39	+51	+45	50	80
-190	- 6.5	- 9.5	-7	-7	+2	+2	+11	+11	+20	+20	+32	+32		
0	+ 7.5	+11	+6	+13	+18	+25	+28	+35	+38	+45	+59	+52	80	120
-220	- 7.5	-11	-9	-9	+3	+3	+13	+13	+23	+23	+37	+37		
0	+9	+ 12.5	+7	+14	+21	+28	+33	+40	+45	+52	+68	+61	120	180
-250	-9	- 12.5	-11	-11	+3	+3	+15	+15	+27	+27	+43	+43		
0	+10	+ 14.5	+7	+16	+24	+33	+37	+46	+51	+60	+79	+70	180	250
-290	-10	- 14.5	-13	-13	+4	+4	+17	+17	+31	+31	+50	+50		
0	+ 11.5	+16	+7	+16	+27	+36	+43	+52	+57	+66	+88	+79	250	315
-320	- 11.5	-16	-16	-16	+4	+4	+20	+20	+34	+34	+56	+56		
0	+ 12.5	+18	+7	+18	+29	+40	+46	+57	+62	+73	+98	+87	315	400
-360	- 12.5	-18	-18	-18	+4	+4	+21	+21	+37	+37	+62	+62		

JS7	JS6	J7	J6	K6	K7	M6	M7	N6	N7	N9	P7	P9	over	up to
+5	+3	+4	+2	0	0	-2	-2	-4	-4	-4	-6	-6	-	3
-5	-3	-6	-4	-6	-10	-8	-12	-10	-14	-29	-16	-31		
+6	+4	+6	+5	+2	+3	-1	0	-5	-4	0	-8	-12	3	6
-6	-4	-6	-3	-6	-9	-9	-12	-13	-16	-30	-20	-42		
+ 7.5	+ 4.5	+8	+5	+2	+5	-3	0	-7	-4	0	-9	-15	6	10
- 7.5	- 4.5	-7	-4	-7	-10	-12	-15	-16	-19	-36	-24	-51		
+9	+ 5.5	+10	+6	+2	+6	-4	0	-9	-5	0	-11	-18	10	18
-9	- 5.5	-8	-5	-9	-12	-15	-18	-20	-23	-43	-29	-61		
+ 10.5	+ 6.5	+12	+8	+2	+6	-4	0	-11	-7	0	-14	-22	18	30
- 10.5	- 6.5	-9	-5	-11	-15	-17	-21	-24	-28	-52	-35	-74		
+ 12.5	+8	+14	+10	+3	+7	-4	0	-12	-8	0	-17	-26	30	50
- 12.5	-8	-11	-6	-13	-18	-20	-25	-28	-33	-62	-42	-88		
+15	+ 9.5	+18	+13	+4	+9	-5	0	-14	-9	0	-21	-32	50	80
-15	- 9.5	-12	-6	-15	-21	-24	-30	-33	-39	-74	-51	-106		
+ 17.5	+11	+22	+16	+4	+10	-6	0	-16	-10	0	-24	-37	80	120
- 17.5	-11	-13	-6	-18	-25	-28	-35	-38	-45	-87	-59	-124		
+20	+ 12.5	+26	+18	+4	+12	-8	0	-20	-12	0	-28	-43	120	180
-20	- 12.5	-14	-7	-21	-28	-33	-40	-45	-52	-100	-68	-143		
+23	+ 14.5	+30	+22	+5	+13	-8	0	-22	-14	0	-33	-50	180	250
-23	- 14.5	-16	-7	-24	-33	-37	-46	-51	-60	-115	-79	-165		
+26	+16	+36	+25	+5	+16	-9	0	-25	-14	0	-36	-56	250	315
-26	-16	-16	-7	-27	-36	-41	-52	-57	-66	-130	-88	-186		
+ 28.5	+18	+39	+29	+7	+17	-10	0	-26	-16	0	-41	-62	315	400
- 28.5	-18	-18	-7	-29	-40	-46	-57	-62	-73	-140	-98	-202		

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