

**HIWIN®**

Motion Control & Systems



## **Ballscrews & Accessories**



## Welcome to HIWIN

Ballscrews, consist of a ballscrew shaft, a ballscrew nut into which the balls are integrated and the ball recirculation system. Ballscrews are the type of threaded shaft most commonly used in industrial and precision machines. They are used to convert rotary motion into longitudinal motion and vice versa. They display great accuracy and are highly efficient. HIWIN provides a large selection of ballscrews for all your applications.

HIWIN ballscrews are distinguished by their low-friction and precise running, require little drive torque and offer good rigidity with smooth operation. HIWIN ballscrews are available in rolled, peeled and ground versions, making them the optimum product for any application. HIWIN has at its disposal state-of-the-art production facilities, highly qualified engineers and quality-assured manufacturing and assembly and only uses high-grade materials to meet all your requirements.

This catalogue provides technical information and will help you select the right ballscrew for your application.

# Ballscrews

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# Ballscrews

## General information

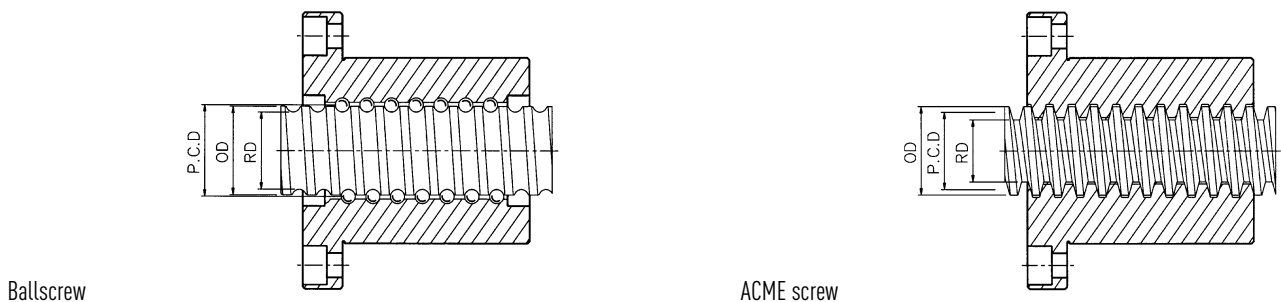
### 1. General information

#### 1.1 Properties

There are many benefits associated with HIWIN ballscrews including high efficiency, reverse operation, freedom from axial backlash, high rigidity and high lead accuracy. Compared with a standard trapezoid screw drive (see Fig. 1.1), the ballscrew has balls

between the threaded shaft and nut. The sliding friction of the trapezoid screw drive is replaced by the rolling motion of the balls. The characteristic properties and resultant benefits of HIWIN ballscrews are described in detail below:

Fig. 1.1 Structure of a ballscrews and contact thread lead screws



Ballscrew

ACME screw

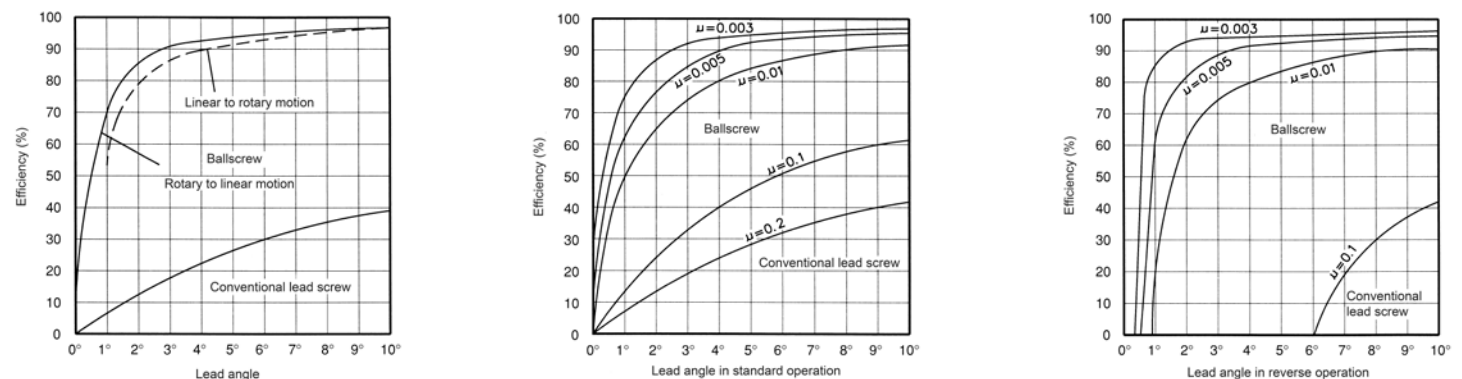
#### 1.1.1 High efficiency in both directions

Thanks to the rolling contact between the shaft and nut, ballscrews can achieve an efficiency of up to 90 %. As a result, the torque required by a ballscrew is only around a third of that of a standard screw drive. Fig. 1.2 shows the significantly higher mechanical efficiency of a ballscrew compared with a standard screw drive. The special surface treatment used on the ball tracks in HIWIN ballscrews reduces the frictional resistance between the ball and its track. The high-quality surface and the

rolling motion of the balls reduce friction and therefore greatly increase the efficiency of the ballscrews.

The rolling motion of the balls only requires a low drive torque thanks to the high level of efficiency. Operating costs are therefore cut since less drive output is needed. HIWIN uses extensive test equipment and procedures to ensure this efficiency.

Fig. 1.2 Mechanical efficiency of threaded shafts

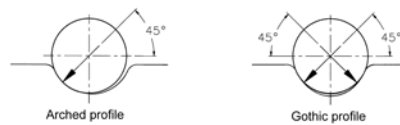


## 1.1.2 Zero backlash and high rigidity

CNC machine tools need ballscrews without backlash and with high rigidity. The pointed profile we use for our ballscrew shafts and nuts allows the ballscrew nuts to be assembled without any axial backlash. A preload is usually used to achieve the good overall rigidity and repeatability needed in CNC machines. However, excessive preload

results in increased friction torque during operation. This friction generates heat and reduces the service life of the screw drive. Special development and manufacturing procedures allow us to manufacture optimized, zero-backlash ballscrews with little inherent heating.

Fig. 1.3 Typical types of contact in ballscrews (arced profile, pointed profile type)



## 1.1.3 High lead accuracy

For applications requiring very high levels of accuracy, our production meets the requirements of ISO, JIS and DIN standards; but we manufacture to customer specifications too.

Accuracy is guaranteed by testing with our laser measurement systems and documented for the customer.

## 1.1.4 Reliable service life

Whereas the life of standard screw drives is determined by wear on the contact surfaces, HIWIN ballscrews can be used virtually up until the end of the metal's fatigue life. Great care is exercised in development, choice of material, heat treatment and manufacturing, as is demonstrated by the reliability and resilience of HIWIN ballscrews over their nominal service life. With every kind of ballscrew, the service life depends

on several influencing factors including design aspects, material quality, maintenance and most importantly the dynamic load rating (C).

Profile accuracy, material properties and surface hardness are the fundamental factors affecting the dynamic load rating.

## 1.1.5 Low starting torque with smooth operation

Metal on metal sliding friction means that standard screw drives require high starting torques to overcome the friction torque. The rolling friction of the balls in ballscrews only requires a very low starting torque.

To achieve precise ball tracks, HIWIN uses a special design (adaptation factor) and special production procedures. This guarantees that the motor's drive torque remains in the range required.

In one particular step of manufacturing, HIWIN can check the profile of every single ball track. A sample report of this test is shown in Fig. 1.4.

Using computer-based measuring systems, the friction torque of every ballscrew is recorded and documented with great accuracy at HIWIN. Fig. 1.5 shows typical torque progress over travel.

Fig. 1.4 Ball arch profile testing at HIWIN

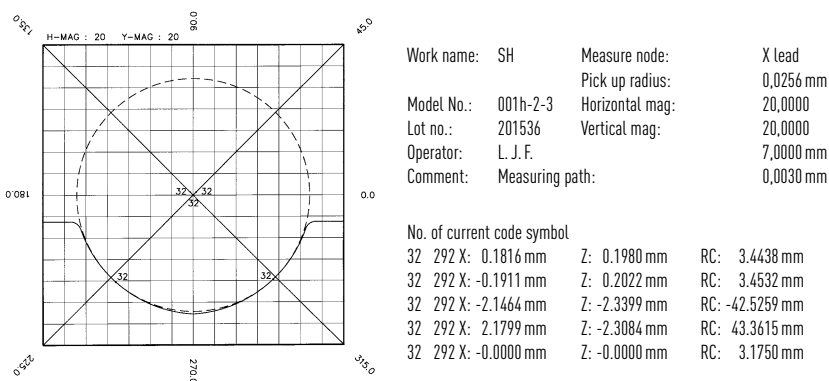
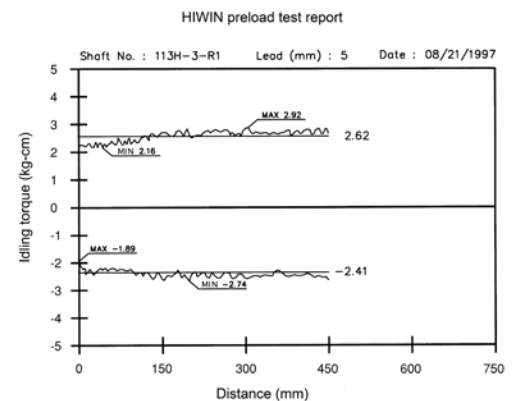


Fig. 1.5 Preload testing at HIWIN



## General information

### 1.1.6 Low noise level

Low noise levels are needed on high-quality machine tools even when working at high feed speeds and under high load. HIWIN ballscrews achieve this thanks to high-grade recirculation systems, the special design of the ball track, well-engineered assembly procedures and careful checking of surfaces and dimensions.

### 1.1.7 Short delivery times

Thanks to high-speed production lines and logistics, HIWIN provides short delivery times.

### 1.1.8 Areas of application for ballscrews

The typical areas of application for HIWIN ballscrews are listed below; the tolerance class required in each case can be found in [Table 2.3](#).

- a) CNC machines: CNC machining centres, CNC lathes, CNC metal processing machines, CNC eroding machines, CNC grinding machines, wood processing machines, drilling machines, special machines
- b) Precision machines: Milling machines, grinding machines, eroding machines, tool grinding machines, gear grinding machines, drilling machines, planing machines etc.
- c) Industrial machines: Printing machines, paper processing machines, automation systems, textile machines, deep drawing machines etc.
- d) Electronic systems: Robot measuring devices, X-Y tables, medical equipment, placement machines, semiconductor manufacturing, system automation etc.
- e) Aviation industry: Aircraft flaps, thrust reversers, loading systems at airports, rocket fins
- f) Miscellaneous: Antenna adjustment devices, valve actuation

### 1.1.9 Ball recirculation systems

HIWIN ballscrews are available with three different recirculation systems.

The external recirculation system comprises the ballscrew shaft, ballscrew nut, steel balls, ball recirculation system and clamping plate. The balls are placed in the ball track between the ballscrew shaft and nut. At the end of the nut, they are guided out of the ball track and back to the start via a return tube; ball circulation is therefore a closed circuit (see [Fig. 1.6](#)).

The internal recirculation system comprises the ballscrew shaft, ballscrew nut, steel balls and deflecting parts. The balls undertake just one circuit around the shaft. The circuit is closed by a deflecting part in the ballscrew nut and allows the balls to return to the start via the rear of the thread. The position of the ball deflection in the nut gives the internal recirculation system its name (see [Fig. 1.7](#)).

Fig. 1.6 External recirculation type nut with return tubes

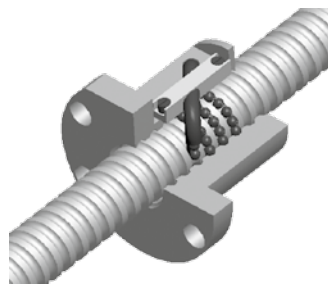
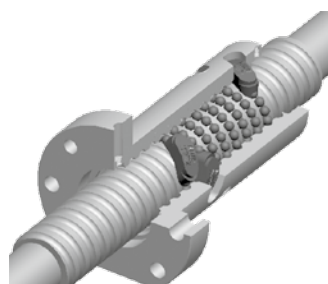


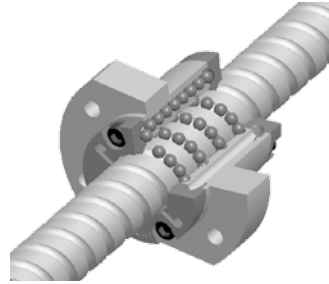
Fig. 1.7 Internal recirculation type nut with return caps (RSI type)





The third type of return is the endcap recirculation system shown in Fig. 1.8. It has the same basic principle as the external return, however, the balls are returned via a channel in the ballscrew nut. The balls perform one complete cycle in the ballscrew nut. The endcap return or "internal total recirculation" provides good loading capacity with short track lengths and small nut diameters.

Fig. 1.8 Endcap recirculation type nut with recirculation system (FSC type)



#### 1.1.10 Standard ballscrew shafts

Table 1.1 Overview of lead available depending on diameter

Version	Miniature					Regular								High lead					Very high lead					
Dia. / lead	1	1,5	2	2,5	3	3,175	4	4,23	5	5,08	6	6,35	8	10	12	12,7	16	20	24	25	25,4	32	40	50
6	G	G	G																					
8	G	G	GR	GR	R								G											
10	G	G	GR	GR	R		GR		R					G										
12		G	GR	GR	R		GR		GR	R				G	R									
14				R	R		R		R															
15									R					GR				GR						
16			GR	GR			GR		GRW	GR			G	GR			GR					G		
20			G	GR			GR		GRW	GR	GRW		R	GR			G	GR					G	
22									G	G														
25				G			GR		GRW	GR	GW	G	GRW	GRW		G	G	G		GR				G
28								G	GR	G	GR	G		G								R		
32						G	GR		GRW	GR	GRW	G	GRW	GRW	G	G		GRW		G	G	G		
36									GR	R	GR		GR	GR	GR			R						
40				G	G		G		GRW	GR	GRW	G	GRW	GRW	GRW	G	G	GRW		G			G	G
45									G	G				GR	GR			R						
50									GRW	G	GR	G	GW	GRW	GRW	G	R	GRW		G			GR	GR
55													G	GR	G	G								
63												G	GW	GRW	GW	G	GR	GRW			G		GR	G
70														G	G				G					
80														GW	G	G	G	GW						
100															G		G	G						

G: Precision-ground ballscrew, available with right-hand or left-hand thread

W: Peeled ballscrew, partly also available with left-hand thread

R: Rolled ballscrew, partly also available with left-hand thread

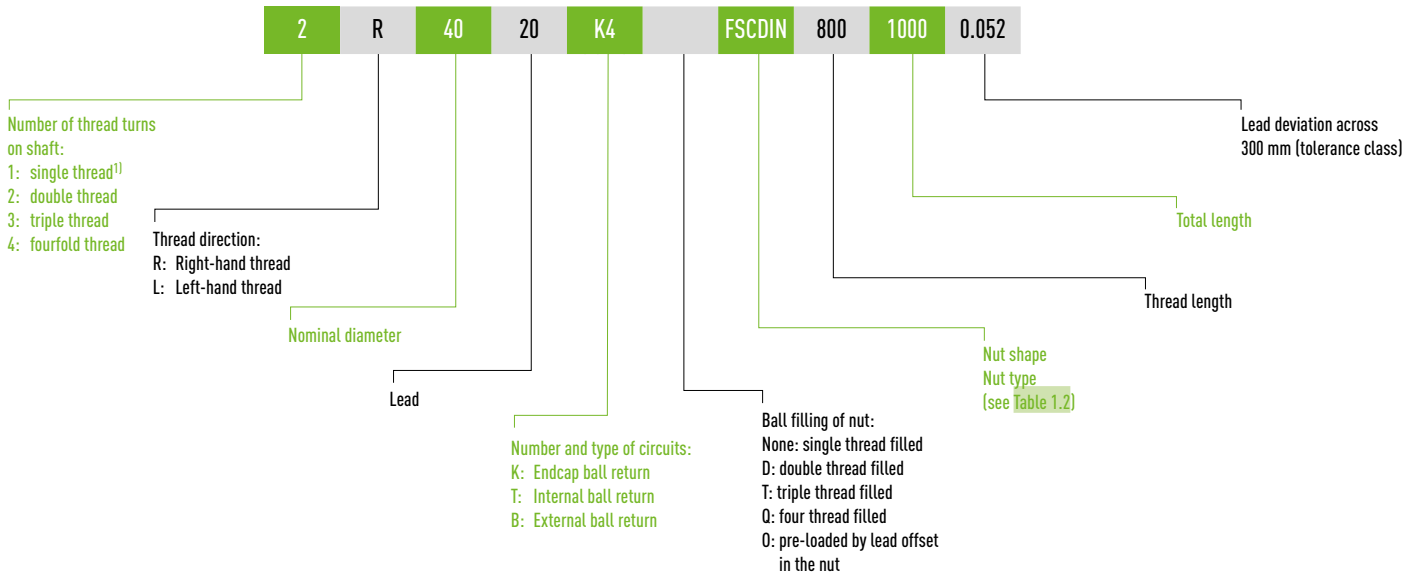
Unit: mm

# Ballscrews

## General information

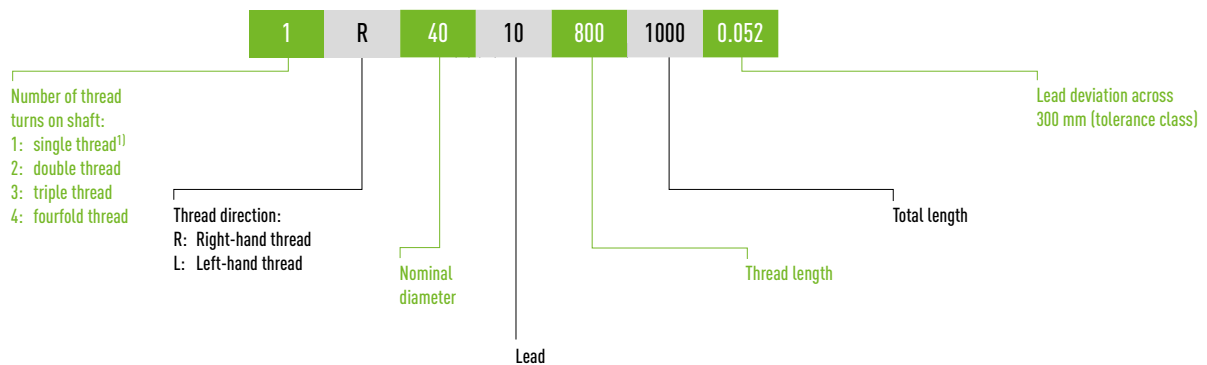
### 1.2 HIWIN order code

In order to clearly identify the ballscrew, information about the ballscrew shaft and nut is needed.



<sup>1)</sup> Standard; can be omitted with single-thread shafts

### Details about the ballscrew shaft without the nut



<sup>1)</sup> Standard; can be omitted with single-thread shafts

### Details about the ballscrew nut without the shaft

The nut designations vary depending on whether a rolled, peeled or ground ballscrew is used.

Details of the ballscrew nut:

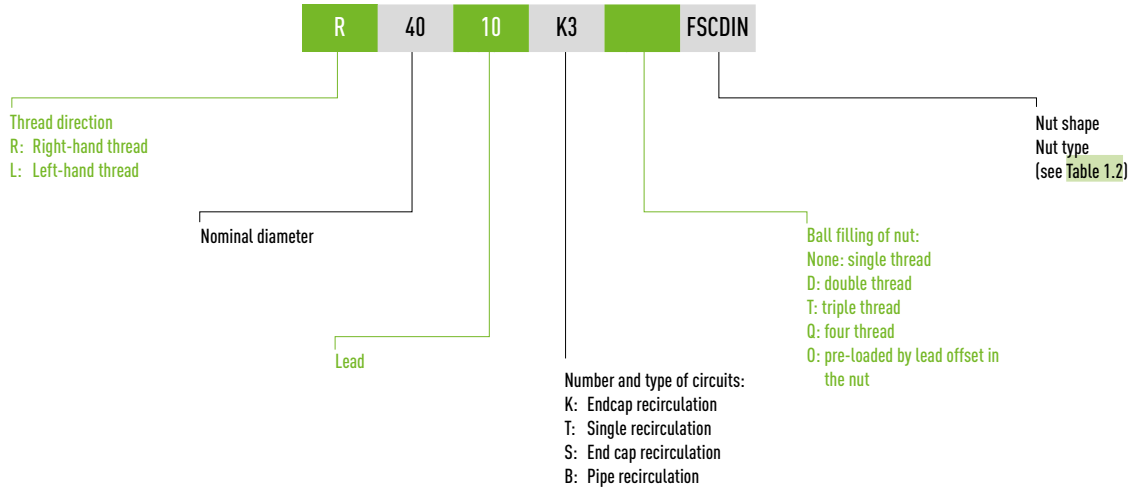


Table 1.2 Overview of nut shapes

Nut designation	Description
<b>DEB</b>	Flange single nut according to DIN69051, Part 5 for peeled ballscrew shafts
<b>DDB</b>	Flange double nut according to DIN69051, Part 5 for peeled ballscrew shafts
<b>FSIDIN/FSCDIN</b>	Flange single nut according to DIN69051, Part 5 for rolled and ground ballscrew shafts. The "DIN" addition is not used for customised flange nuts which do not correspond to DIN
<b>RSI</b>	Cylindrical single nut for rolled and ground ballscrew shafts
<b>RSIT</b>	Cylindrical single nut with screw-in thread for rolled ballscrew shafts
<b>SE</b>	Cylindrical single nut with screw-in thread for peeled ballscrew shafts
<b>SEM</b>	Flange single nut with integrated locking nut for peeled ballscrew shafts
<b>ZE</b>	Cylindrical single nut for peeled ballscrew shafts
<b>ZD</b>	Cylindrical double nut for peeled ballscrew shafts
<b>FSV</b>	Nut with reinforced recirculation system for heavy-duty operation

### 1.3 Special solutions

HIWIN manufactures ballscrews in line with customer drawings or with HIWIN standard end machining. The following points must be defined and/or checked for the ballscrew definition. This ensures that the ballscrew is ideally adapted to the requirements in place.

1. Nominal diameter
2. Thread lead
3. Thread total length
4. Bearing journal configuration
5. Ballscrew nut configuration
6. Level of accuracy (lead deviation, tolerances)
7. Operating speed
8. Maximum static load, operating load, idle torque
9. Safety requirements of ballscrew nut
10. Position of lubrication holes

# Ballscrews

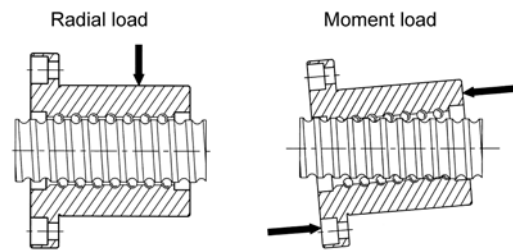
## Properties and selection

### 2. Structural properties and selection of HIWIN ballscrews

#### 2.1 Design and assembly information

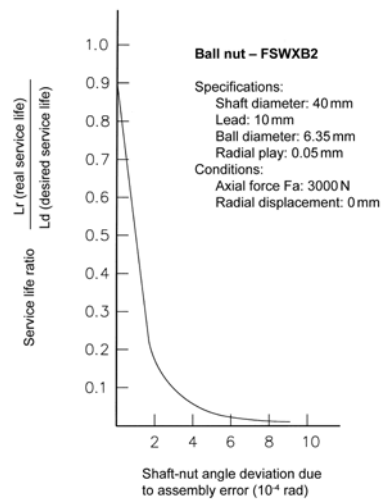
- a) Ballscrews must be carefully cleaned using benzine and oil to protect against corrosion. Trichloroethylene is a suitable grease removal agent for protecting the ball track from dirt and damage; paraffin is not sufficient. Damage to the ball track by pointed objects must be avoided in all circumstances. Metal particles must also not enter the ball track.
- b) Select a suitable ballscrew for your application (see Table 2.3). The relevant requirements must be noted for installation. For precision-ground ballscrews with CNC machines, this means careful alignment and the corresponding type of installation; for applications requiring less precision, we recommend rolled ballscrews, which require less work when designing the type of installation and bearings.

Fig. 2.1 **Uneven load distribution**, caused by insufficient alignment of support bearing and ballscrew nut, incorrect configuration of mounting surface, incorrect angle or error in aligning the nut flange



It is particularly important that the bearing housing and ballscrew nut are assembled axially parallel; otherwise uneven load distribution would result (see Fig. 2.1). Radial and torque loads are also among the factors which result in uneven load distribution (see Fig. 2.1). This can cause functional limitations and shorten the service life (see Fig. 2.2).

Fig. 2.2 **Impacts on life expectancy** of radial load caused by insufficient alignment



- c) In order to attain the maximum service life, a suitable oil or grease must be used. Additives containing graphite or  $\text{MoS}_2$  must not be used (see chapter 2.7). Oil misting baths or drip oil lubrication are permitted, but direct lubrication of the ballscrew nut is recommended.

- d) Select the right type of bearing for the ballscrew shaft. When used in CNC machines, we recommend angular ball bearings (angle = 60°) because of their higher axial load capacity and the fact that they permit zero-backlash or pre-loaded installation.

A selection of possible end machining processes and suitable floating and fixed bearings are listed in chapter 7 onwards.

- e) Precautionary measures must be taken to stop the ballscrew nut once the useful path has been exceeded (see Fig. 2.3). Travel against an axial fixed stop results in damage.

- f) In environments with high levels of dust or metal debris, ballscrews should be provided with a telescopic or bellows shaft protection (Fig. 2.4).

- g) When using an internal or end cap ball recirculation system, the ball thread must be cut to the end of the shaft. The diameter of the adjacent bearing journal must be around 0.5–1.0 mm less than the core diameter of the ball tracks (see Fig. 2.5).

- h) While surface-hardening the shafts, 2 to 3 thread turns are left unhardened on the two ends adjacent to the bearings so that connection modifications are possible. These areas are marked with the symbol in HIWIN drawings (see Fig. 2.6). Please contact HIWIN if you have special requirements for these areas.

- i) Excess preload results in increased friction torque which in turn causes heating and therefore a reduced service life. On the other hand, insufficient preload reduces rigidity and increases the risk of backlash. For use in CNC machines, HIWIN recommends a maximum preload of 8 % of the dynamic load rating C.

- k) Should it be necessary for the ballscrew nut to be removed from the shaft, a tube with an outer diameter around 0.2 to 0.4 mm smaller than the core diameter of the ball tracks should be used. The nut and shaft are fitted and removed via one end of the threaded shaft (see Fig. 2.7).

Fig. 2.3 **Mechanical stop which prevents the travel distance from being exceeded.**

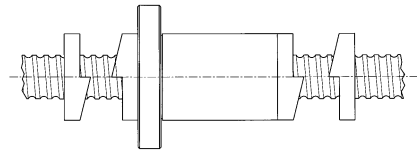


Fig. 2.4 **Telescopic or bellows shaft protection**

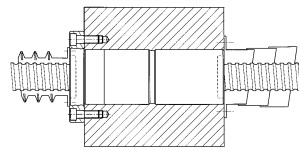


Fig. 2.5 **Special requirement of bearing journal with internal recirculation system**

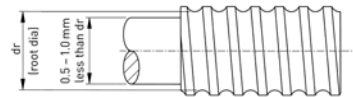


Fig. 2.6 **Area of surface hardening on a ballscrew shaft**

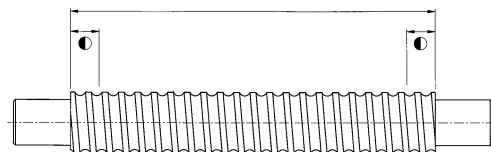
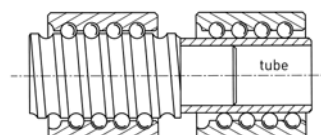


Fig. 2.7 **Procedure for separating ballscrew nut and shaft**



# Ballscrews

## Properties and selection

- l) The support bearing needs a recess to allow for an exact fit and exact alignment (see Fig. 2.8). HIWIN recommends a recess in accordance with DIN 509 as the standard design (Fig. 2.9). The ball thread in rolled and peeled shafts emerges in the bearing installation surface. In the worst cases, the bearing installation surface becomes too small and is no longer closed in a circular fashion. The specified bearing concentricity is then no longer ensured. A smaller inner bearing diameter or an appropriately produced peeled/ground shaft without thread emergence will solve this problem. For secondary applications, a support ring can also be pressed on.

Fig. 2.8 Recess for positioning end bearings

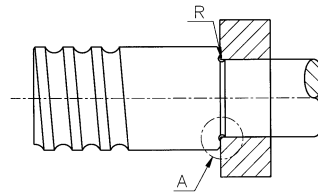
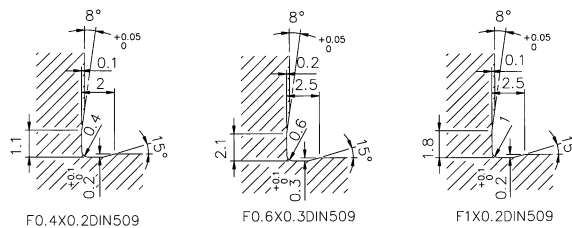


Fig. 2.9 Recommended recess dimensioning of "A" in Fig. 2.8 according to DIN 509



### 2.2 Procedure for selecting a ballscrew

Table 2.1 shows the procedure for selecting a ballscrew. The usage requirements (A) can be used to determine the necessary ballscrew parameters (B). The ballscrew suited to the application can therefore be determined one step at a time following the information provided (C).

Table 2.1 Procedure for selecting a ballscrew

Step	Usage requirement (A)	Ballscrew parameter (B)	Reference (C)
1	Positioning accuracy	Lead accuracy	Table 3.1, Table 4.1, Table 5.1
2	1 Max. speed of DC motor ( $n_{max}$ ) 2 Rapid motion speed ( $v_{max}$ )	Lead of screw drive	$p = \frac{v_{max}}{n_{max}}$
3	Total length of travel distance	Total length of thread	Total length = thread length + length of end machining Thread length = travel distance + length of nut + distance which cannot be used due to connection design (e.g. nut housing, bearing housing etc.)
4	1 Load conditions [%] 2 Speed conditions [%] ( $\leq 1/5$ C recommended)	Average axial load Average speed	Formulas F 2.2 – F 2.7
5	Average axial force	Preload	Formula F 2.3
6	1 Nominal service life 2 Average axial load 3 Average speed	Dynamic load rating	Chapter 2.5.1, Service life
7	1 Dynamic load rating 2 Lead of ball screw 3 Critical speed 4 Speed limitation by $D_N$ value	Shaft diameter and nut type	Chapter 2.5.1, Service life
8	1 Diameter of ball screw 2 Nut type 3 Preload 4 Dynamic load rating	Rigidity	Chapter 2.5.6, Rigidity
9	1 Ambient temperature 2 Length of ball screw	Thermal deformation and final value of cumulative lead (T)	Chapter 2.5.7, Thermal expansion Chapter 2.6, Effects of temperature increases
10	1 Shaft rigidity 2 Thermal deformation	Preload	Chapter 2.6, Effects of temperature increases
11	1 Max. table speed 2 Max. start-up time 3 Configuration of ballscrew	Motor drive torque and configuration of motor	Chapter 2.5.2, Drive torque and drive output of motor

## 2.3 Accuracy of the HIWIN ballscrews

Ground ballscrews are used in situations where a high level of positioning and repeat accuracy, smooth running and a long service life are needed. Rolled ballscrews are used where the accuracy requirements are not quite as strict but the same levels of performance and service life are required. The accuracy of peeled ballscrews is between that of rolled and precision-ground ballscrews. They can take the place of certain precision-ground ballscrews of the same tolerance class in many applications. HIWIN manufactures rolled and peeled ballscrews up to an accuracy of T5 grade (see

chapters 3 and 4). Since the outer diameter of the shafts on precision-rolled ballscrews is not ground, the installation and commissioning process differs from that for ground shafts. Chapter 3 provides all the details of the properties of rolled ballscrew shafts.

### 2.3.1 Tolerance class

The possible applications for ballscrews range from use with very high accuracy requirements in precision measuring technology or in aircraft construction to use as a transport screw in the packaging industry. The following factors are used to determine the tolerance class: lead deviation, surface roughness, tolerances, axial backlash, friction torque deviations, generation of heat and noise level.

HIWIN ballscrews are split into eight tolerance classes. HIWIN precision-ground ballscrews are generally defined using what is known as the "e300 value" whereas larger tolerances are permitted for rolled ballscrews being used as transport ballscrews.

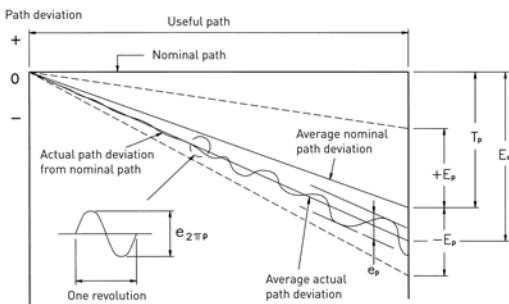
### 2.3.2 Axial backlash

If ballscrews with no axial backlash are needed, preload should be used and the idle torque for test purposes defined. In CNC machines, insufficient rigidity may result in

Fig. 2.10 shows the measured lead trends for each level of accuracy. Fig. 2.11 shows the same details using a DIN-compliant measuring device. This diagram can be used to determine the necessary tolerance and therefore the tolerance class needed in Table 5.1. Fig. 2.12 shows the HIWIN measurement results according to DIN. Table 2.2 lists the international standards.

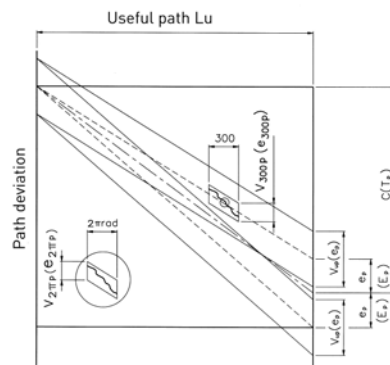
The positioning accuracy of machine tools is determined with the  $\pm E$  value using the e300 deviation. The recommended level of accuracy during use in the machine can be found in Table 2.3. The appropriate ballscrew for the application in hand can be selected using this table.

Fig. 2.10 HIWIN measurement curve of lead of precision ballscrews

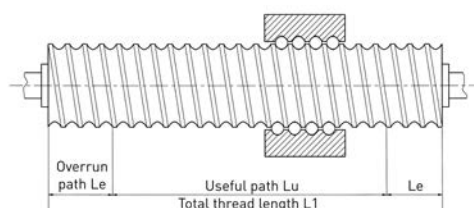


- $T_p$  = Difference between nominal and actual path. This value is determined by the various requirements of the customer's application.
- $E_p$  = Maximum actual path deviation from nominal path over complete distance.
- $e_{2\pi p}$  = Path deviation within one revolution
- $E_a$  = Actual path, determined using laser measurement
- $e_p$  = Actual path deviation. Maximum deviation of total actual path from actual total nominal path in the corresponding area
- $e_{300p}$  = Actual path deviation at 300 mm. Actual path deviation over 300 mm at any thread position

Fig. 2.11 DIN measurement curve of lead of ballscrews



- $e_{0a}(E_a)$  = Average actual path deviation over useful path Lu.
- $c(T_p)$  = Path compensation over useful path Lu.
- $e_p(E_p)$  = Limit deviation of nominal path
- $V_{up}(e_p)$  = Permissible path deviation over useful path Lu
- $V_{300p}(e_{300p})$  = Permissible path deviation over 300 mm
- $V_{2\pi p}(e_{2\pi p})$  = Permissible path deviation over one revolution



# Ballscrews

## Properties and selection

HIWIN ballscrews are produced in various tolerance classes. As an international company, we produce ballscrews on the basis of DIN 69051 and ISO 3408 in tolerance classes 1, 3, 5, 7 and 10 and in accordance with the Japanese standard JIS in classes 0, 2 and 4. The tolerance classes are listed in [Table 2.2](#).

Table 2.2 International standards for tolerance classes of ballscrews

HIWIN Tolerance class		T0	T1	T2	T3	T4	T5	T7	T10
e <sub>300</sub>	ISO, DIN		6		12		23	52	210
	JIS	3,5		8		18			

Fig. 2.12 Curves of lead accuracy when measuring on a laser measuring device according to DIN 69051

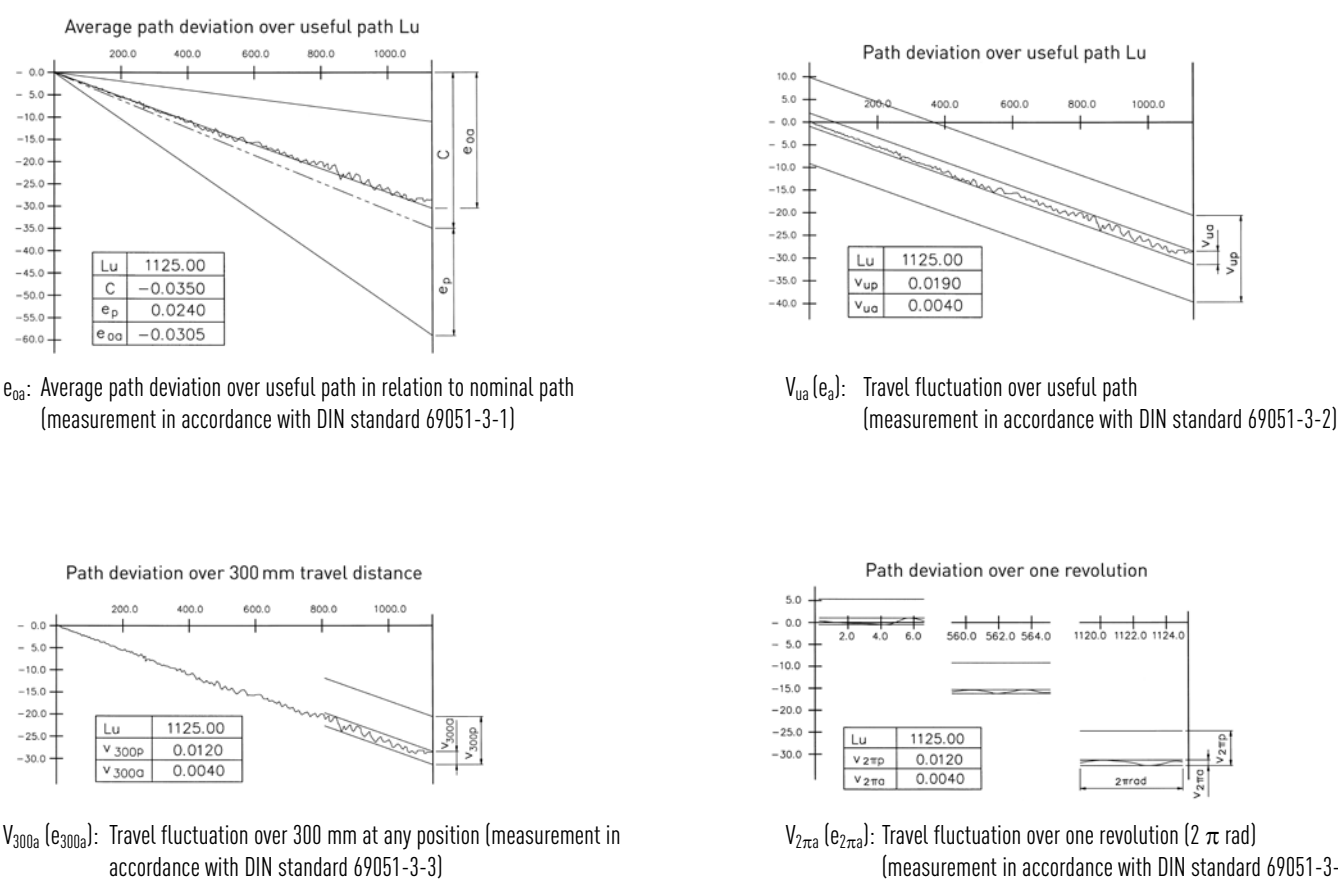
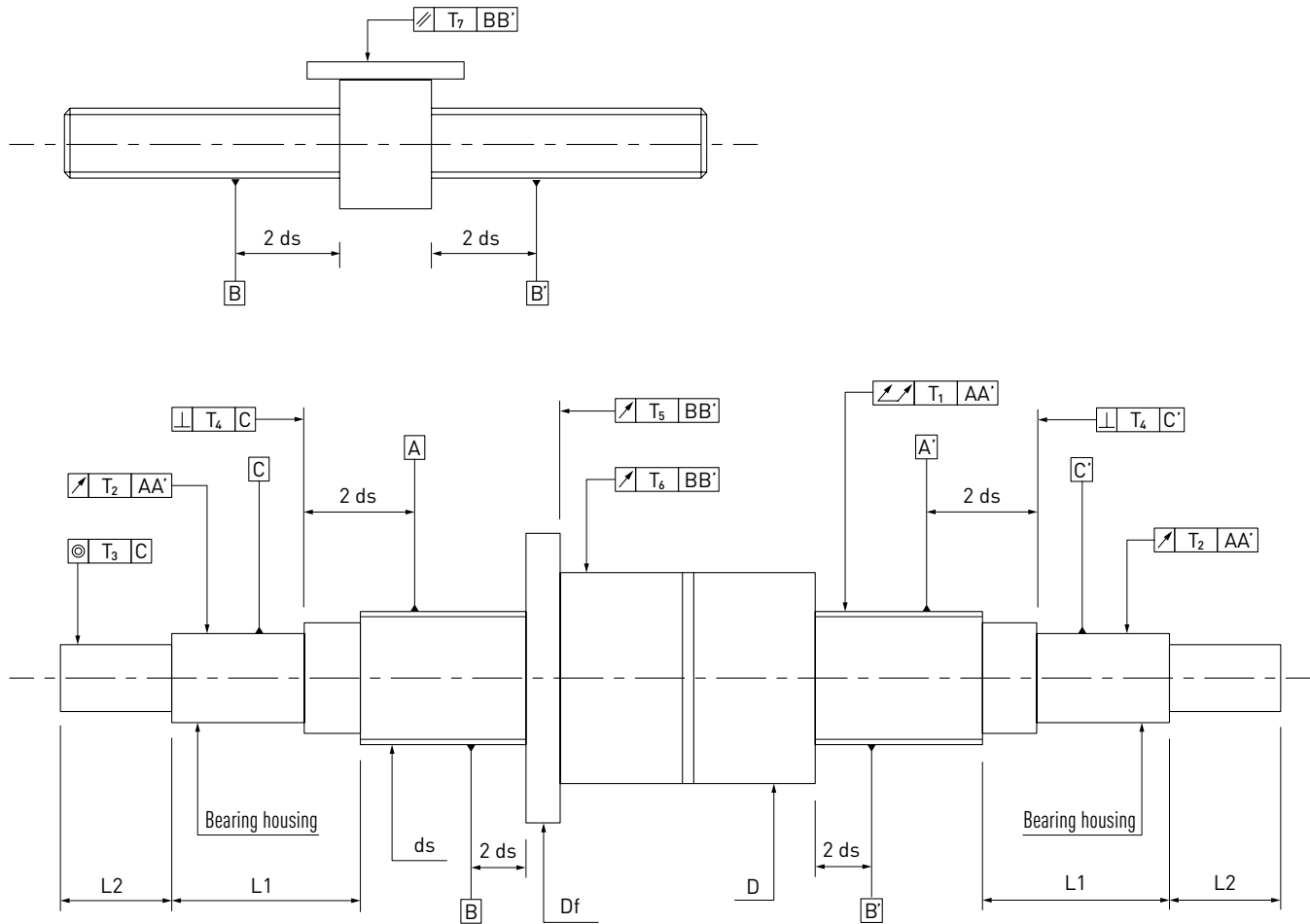




Fig. 2.13 Tolerances of ground ballscrews from HIWIN



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Table 2.3 Recommended tolerance classes for various applications

Application		Axis	Tolerance class						
			T0	T1	T2	T3	T4	T5	T7
CNC machine tools	Turning	X	○	○	○	○	○		
		Z				○	○	○	
	Milling Bore milling	X		○	○	○	○	○	
		Y		○	○	○	○	○	
		Z			○	○	○	○	
	Machining centres	X		○	○	○	○		
		Y		○	○	○	○		
		Z			○	○	○		
	Coordinate drilling	X	○	○					
		Y	○	○					
		Z	○	○					
	Drilling	X				○	○	○	
		Y				○	○	○	
		Z					○	○	○
	Grinding	X	○	○	○				
		Y		○	○	○			
	Die sinking	X		○	○	○			
		Y		○	○	○			
		Z			○	○	○	○	
	Wire eroding	X		○	○	○			
		Y		○	○	○			
		U		○	○	○	○		
		V		○	○	○	○		
	Laser cutting	X			○	○	○		
		Y			○	○	○		
		Z			○	○	○		
Other machines	Punching machine	X				○	○	○	
		Y				○	○	○	
	Wood processing machines								○
	Precision industrial robots			○	○	○	○		
	Industrial robots							○	○
	Coordinate measuring device		○	○	○				
	Non-CNC machines					○	○	○	
	Transport units						○	○	○
	X-Y tables			○	○	○	○	○	
	Linear electric lifting cylinders							○	○
	Aircraft landing gear							○	○
	Wing control							○	○
	Gate valves								○
	Power-assisted steering systems								○
	Glass grinders				○	○	○	○	○
	Surface grinders						○	○	
	Induction hardening machine								○
	Electric machines			○	○	○	○	○	○

## Tolerance details and measuring methods for HIWIN ballscrews

Table 2.4 Effective concentricity deviation of outer diameter with reference to AA' (measurement in accordance with DIN 69051)

Nominal diameter [mm]		Reference length	$t_{5p}$ [μm] HIWIN tolerance class						
above	up to	L5	T0	T1	T2	T3	T4	T5	T7
6	12	80	16	20	23	25	25	32	40
12	25	160							
25	50	315							
50	100	630							
100	200	1250							

$L_t / d_o$		$t_{5max}$ [μm] (for $L_t \geq 4L_5$ ) HIWIN-tolerance class						
above	up to	T0	T1	T2	T3	T4	T5	T7
	40	32	40	45	50	50	64	80
40	60	48	60	70	75	75	96	120
60	80	86	100	115	125	125	160	200
80	100	128	160	180	200	200	256	320

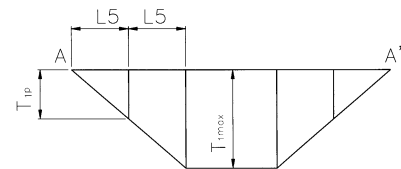
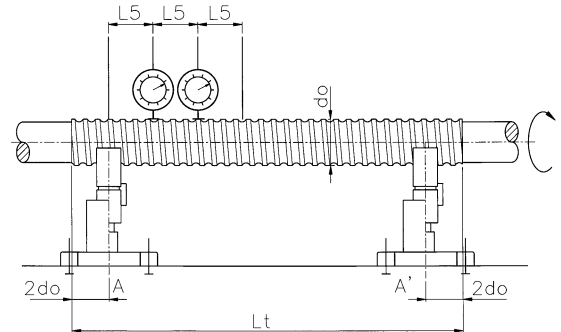


Table 2.5 Concentricity deviation of bearing with reference to AA' (measurement in accordance with DIN 69051)

Nominal diameter [mm]		Reference length	$t_{6p}$ [μm] (for $L_1 \leq L_r$ ) HIWIN tolerance class						
über	bis zu	Lr	T0	T1	T2	T3	T4	T5	T7
6	20	80	6	10	11	12	12	20	40
20	50	125	8	12	14	16	16	25	50
50	125	200	10	16	18	20	20	32	63
125	200	315	—	—	20	25	25	40	80

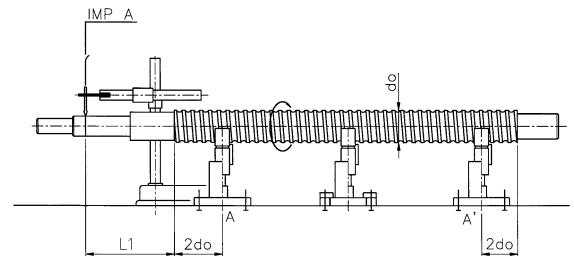
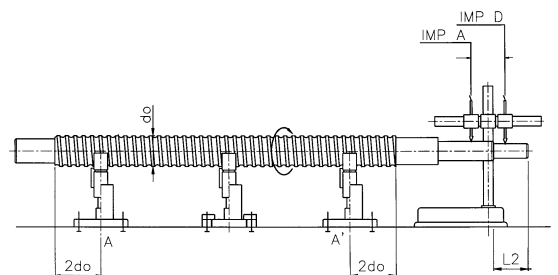


Table 2.6 Coaxial deviation of drive journal with regard to bearing journal with reference to AA' (measurement in accordance with DIN 69051)

Nominal diameter [mm]		Reference length	$t_{7p}$ [μm] (for $L_2 \geq L_r$ ) HIWIN tolerance class						
über	bis zu	Lr	T0	T1	T2	T3	T4	T5	T7
6	20	80	4	5	6	6	6	8	12
20	50	125	5	6	7	8	8	10	16
50	125	200	6	8	8	10	10	12	20
125	200	315	—	—	10	12	12	16	25



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Table 2.7 Axial runout deviation of bearing journal shoulder with reference to AA' (measurement in accordance with DIN 69051)

Nominal diameter [mm]		$t_{9p}$ [ $\mu\text{m}$ ] HIWIN tolerance class						
über	bis zu	T0	T1	T2	T3	T4	T5	T7
6	63	3	3	3	4	4	5	6
63	125	3	4	4	5	5	6	8
125	200	—	—	6	6	6	8	10

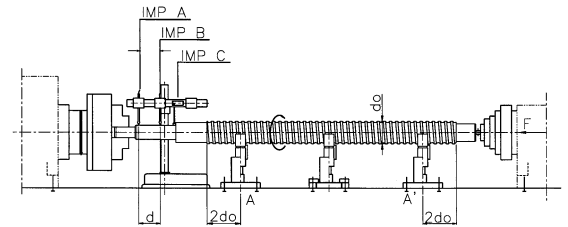


Table 2.8 Axial runout deviation of installation surface of ballscrew nut (only for preloaded ballscrew nuts) with reference to BB' (measurement in accordance with DIN 69051)

Flange diameter [mm]		$t_{9p}$ [ $\mu\text{m}$ ] HIWIN tolerance class						
über	bis zu	T0	T1	T2	T3	T4	T5	T7
16	32	8	10	10	12	12	16	20
32	63	10	12	12	16	16	20	25
63	125	12	16	16	20	20	25	32
125	250	16	20	20	25	25	32	40
250	500	—	—	15	32	32	40	50

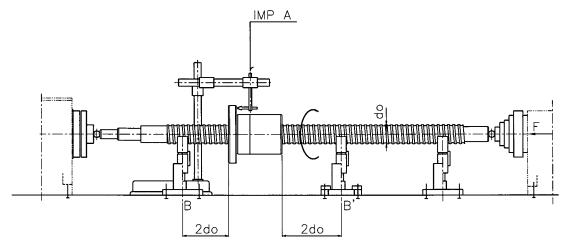


Table 2.9 Concentricity deviation of outer diameter of threaded nut (only for preloaded and turning ballscrew nuts) with reference to BB' (measurement in accordance with DIN 69051)

Diameter [mm] Nut body		$t_{10p}$ [ $\mu\text{m}$ ] HIWIN tolerance class						
über	bis zu	T0	T1	T2	T3	T4	T5	T7
16	32	8	10	10	12	12	16	20
32	63	10	12	12	16	16	20	25
63	125	12	16	16	20	20	25	32
125	250	16	20	20	25	25	32	40
250	500	—	—	—	32	32	40	50

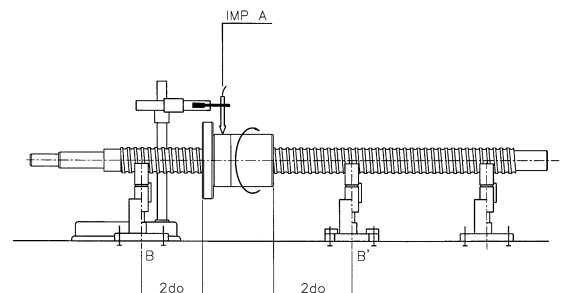
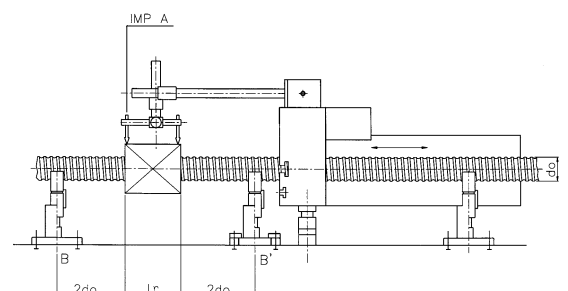


Table 2.10 Parallelism deviation of a square ballscrew nut (only for preloaded ballscrew nuts) with reference to BB' (measurement in accordance with DIN 69051)

$t_{11p}$ [ $\mu\text{m}$ ] / 100 mm, cumulative HIWIN tolerance class						
T0	T1	T2	T3	T4	T5	T7
14	16	16	20	20	25	32

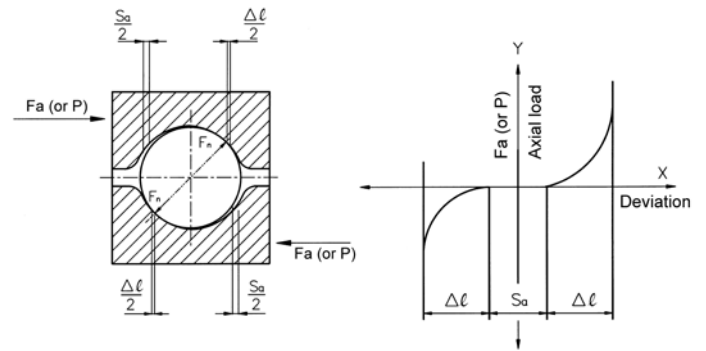


## 2.4 HIWIN types of preload

The Gothic arch profile permits a ball contact angle of  $45^\circ$ . The axial force  $F_a$ , caused by outer drive forces or inner preload forces, produces two kinds of axial backlash. Firstly, axial backlash  $S_a$ , that originates from the air between the ball and ball track. Secondly, the spring compression play  $\Delta l$ , caused by the force  $F_n$ , which acts vertically on the point of contact.

The axial backlash can be cancelled by a preload force  $P$ . This preload can be generated with a double nut, a single nut with lead offset or with preloaded single nuts by adapting the ball size.

Fig. 2.14 Gothic arch profile and preload

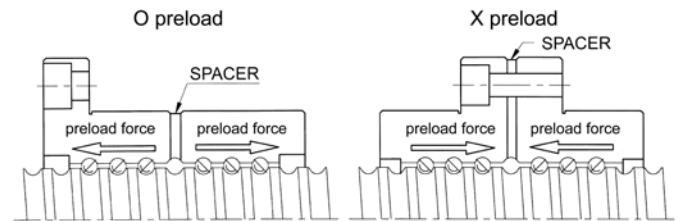


### 2.4.1 Preload of double nuts

The preload is generated by inserting a spacer between the nuts (Fig. 2.15). The O preload results from fitting an oversized spacer which pushes the halves of the nut apart. The X preload is generated with an undersized spacer which pulls the nuts together.

If the shaft has to be stretched to increase rigidity, contact HIWIN to find out how much it needs to be stretched. (Recommended amount of stretching: 0.02 – 0.03 mm per metre of shaft length, the amount of stretching must be taken into account when defining the T value)

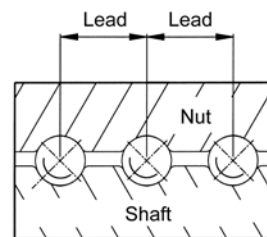
Fig. 2.15 Preload from spacer



### 2.4.2 Preload of single nuts

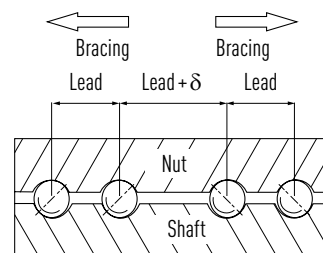
There are two kinds of preload for the single nuts. One of these is the "preload method with oversized balls". This involves balls which are slightly larger than the space in the ball track; the ball therefore makes contact at four points (Fig. 2.16).

Fig. 2.16 Preload from ball size



The other method is known as "preload from lead offset" (see Fig. 2.17). The nut is ground such that it is offset from the central lead. This type of preload takes the place of the classic double nut preload and offers the benefit that a compact single nut with good rigidity can be used with low preload forces. This method is not, however, suited to use with high preloads and high leads. The recommend preload force is less than 5 % of the dynamic load rating (C).

Fig. 2.17 Preload from lead offset



# Ballscrews

## Properties and selection

### 2.4.3 Idle torque fluctuation

#### (1) Measuring method

Preload produces a friction torque between nut and threaded shaft. This is measured by moving the threaded shaft at constant speed while holding the nut with a special locking device (see Fig. 2.19).

The force  $F_{Pr}$  measured by the force sensor is used to calculate the idle torque of the threaded shaft.

HIWIN has developed a computer-assisted measuring device which monitors the idle torque during turning. The idle torque can therefore be set precisely to the customer specification (Fig. 1.5). The standard measuring device for recording idle torque is described in Fig. 2.18 and Table 2.12.

#### F2.1

$$T_d = \frac{K_p \times F_{Pr} \times P}{2000 \times \pi}$$

$T_d$  Idle torque of preloaded nut

$F_{Pr}$  Preload force

$P$  Lead [mm]

$K_p$  Preload friction coefficient

$$K_p = \frac{1}{\eta_1} - \eta_2 \quad (\text{between } 0.1 \text{ and } 0.3)$$

$\eta_1, \eta_2$  are the mechanical efficiencies of the ballscrew

#### (2) Measurement conditions

1. Without wiper
2. Speed: 100 rpm
3. Dynamic viscosity of lubricant 61.2 – 74.8 cSt [mm/s] at 40 °C, complying with ISO VG 68 or JIS K2001

(3) The result of the measurement is displayed using standard depiction of idle torque; the nomenclature is shown in Fig. 2.18.

(4) Fluctuations in idle torque (incorporated in the tolerance class definition) are listed in Table 2.12.

Fig. 2.18 Nomenclature for measuring idle torques

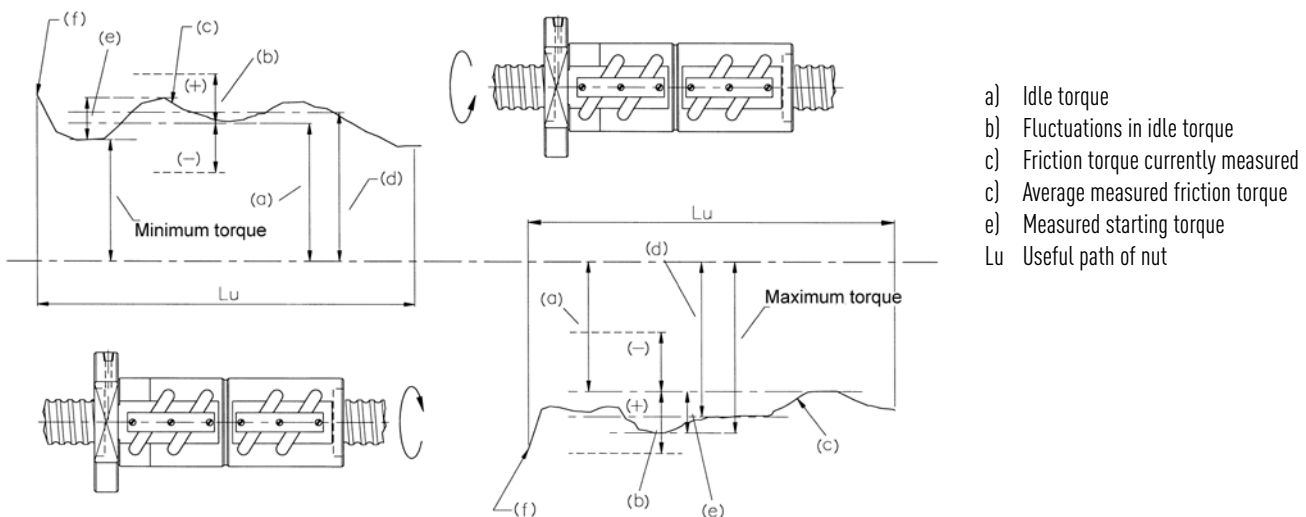


Table 2.11 Fluctuation range of idle torque (in accordance with JIS B1192)

(1) Basic friction torque [Ncm]		Length of useful path of thread [mm]																							
		4000 mm maximum																over 4000 mm							
		Slenderness ratio $\leq 40$ Tolerance class								40 < Slenderness ratio < 60 Tolerance class								Tolerance class							
Above	Up to	T0	T1	T2	T3	T4	T5	T6	T7	T0	T1	T2	T3	T4	T5	T6	T7	T0	T1	T2	T3	T4	T5	T6	T7
20	40	30	35	40	40	45	50	60	—	40	40	50	50	60	60	70	—	—	—	—	—	—	—	—	—
40	60	25	30	35	35	40	40	50	—	35	35	40	40	45	45	60	—	—	—	—	—	—	—	—	—
60	100	20	25	30	30	35	35	40	40	30	30	35	35	40	40	45	45	—	—	—	40	43	45	50	50
100	250	15	20	25	25	30	30	35	35	25	25	30	30	35	35	40	40	—	—	—	35	38	40	45	45
250	630	10	15	20	20	25	25	30	30	20	20	25	25	30	30	35	35	—	—	—	30	33	35	40	40
630	1000	—	15	15	15	20	20	25	30	—	—	20	20	25	25	30	35	—	—	—	25	23	30	35	35

Note:

1. Slenderness ratio = thread length of shaft/nominal diameter of shaft [mm]
2. To calculate the idle torque, see chapter 2.5
3. For more information, please contact HIWIN

# Ballscrews

## Properties and selection

### 2.5 Calculations

Bases of calculations in accordance with DIN 69051 and/or ISO 3408.

#### 2.5.1 Service life

##### a) Average speed $n_m$

**F 2.2**

$$n_m = n_1 \times \frac{t_1}{100} + n_2 \times \frac{t_2}{100} + n_3 \times \frac{t_3}{100} + \dots$$

$n_m$  Average speed, total [rpm]  
 $n_n$  Average speed in phase n [rpm]  
 $t_n$  Amount of time in phase n [%]

##### b) Preload

**F 2.3**

$$F_{pr} = \frac{f_{pr}}{100\%} \times C_{dyn}$$

$F_{pr}$  Preload force  
 $C_{dyn}$  Dynamic load rating  
 $f_{pr}$  Preload factor in %  
 Single nut  $f_{pr} \leq 5\%$   
 Double nut  $f_{pr} \leq 10\%$

**F 2.4**

$$F_{lim} = 2^{3/2} \times F_{pr}$$

$F_{lim}$  Disengagement force

Distinction of cases:

$F_n > F_{lim}$  No influence from preload:  $F_{bn} = F_n$   
 $F_n < F_{lim}$  Influence from preload: Formula **F 2.5**

**F 2.5**

$$F_{bn} = \left(1 + \frac{F_n}{2^{3/2} \times F_{pr}}\right)^{3/2} \times F_{pr}$$

$F_n$  Axial loading in phase n  
 $F_{bn}$  Operating axial loading in phase n

$F_n$  must be calculated for all phases and used in formula **F 2.5**.

##### c) Average operating load $F_{bm}$

○ With alternating load and constant speed:

**F 2.6**

$$F_{bm} = \sqrt[3]{F_{b1}^3 \times \frac{t_1}{100} \times f_{p1}^3 + F_{b2}^3 \times \frac{t_2}{100} \times f_{p2}^3 + F_{b3}^3 \times \frac{t_3}{100} \times f_{p3}^3 \dots}$$

$F_{bm}$  Average operating load [N]  
 $F_{bn}$  Operating axial loading in phase n  
 $f_p$  Operating condition factor  
 $f_p$  1.1 – 1.2 operation without impact  
 1.3 – 1.8 operation under normal conditions  
 2.0 – 3.0 operation with high impact and with vibrations  
 3.0 – 5.0 short-stroke applications  $< 3 \times$  nut length

○ With alternating load and alternating speed:

**F 2.7**

$$F_{bm} = \sqrt[3]{F_{b1}^3 \times \frac{n_1}{n_m} \times \frac{t_1}{100} \times f_{p1}^3 + F_{b2}^3 \times \frac{n_2}{n_m} \times \frac{t_2}{100} \times f_{p2}^3 + F_{b3}^3 \times \frac{n_3}{n_m} \times \frac{t_3}{100} \times f_{p3}^3 \dots}$$



**Axial loading on both sides:**

- Service life in revolutions

**F 2.8**

$$L_1 = \left( \frac{C_{dyn}}{F_{bm1}} \right)^3 \times 10^6$$

$$L_2 = \left( \frac{C_{dyn}}{F_{bm2}} \right)^3 \times 10^6$$

**F 2.9**

$$L = \left( L_1^{-10/9} + L_2^{-10/9} \right)^{-9/10}$$

$L_1$  Service life in revolutions, forward motion  
 $L_2$  Service life in revolutions, backward motion  
 $C_{dyn}$  Dynamic load rating [N]  
 $F_{bm1}$  Average operating load, forward motion  
 $F_{bm2}$  Average operating load, backward motion  
 $L$  Service life in revolutions

- Conversion of service life into operating hours

**F 2.10**

$$L_h = \frac{L}{n_m \times 60}$$

$L_h$  Service life in operating hours  
 $n_m$  Average speed [rpm], see formula **F 2.2**

- Conversion of distance travelled [km] into operating hours:

**F 2.11**

$$L_h = \left( \frac{L_{km} \times 10^6}{P} \right) \times \frac{1}{n_m \times 60}$$

$L_h$  Service life in operating hours  
 $L_{km}$  Service life in distance travelled [km]  
 $P$  Lead [mm]  
 $n_m$  Average speed [rpm]

- The modified service life with different reliability factors is calculated using

**F 2.12**

$$L_m = L \times f_r$$

$$L_{hm} = L_h \times f_r$$

$f_r$  Reliability factor (see **Table 2.12**)

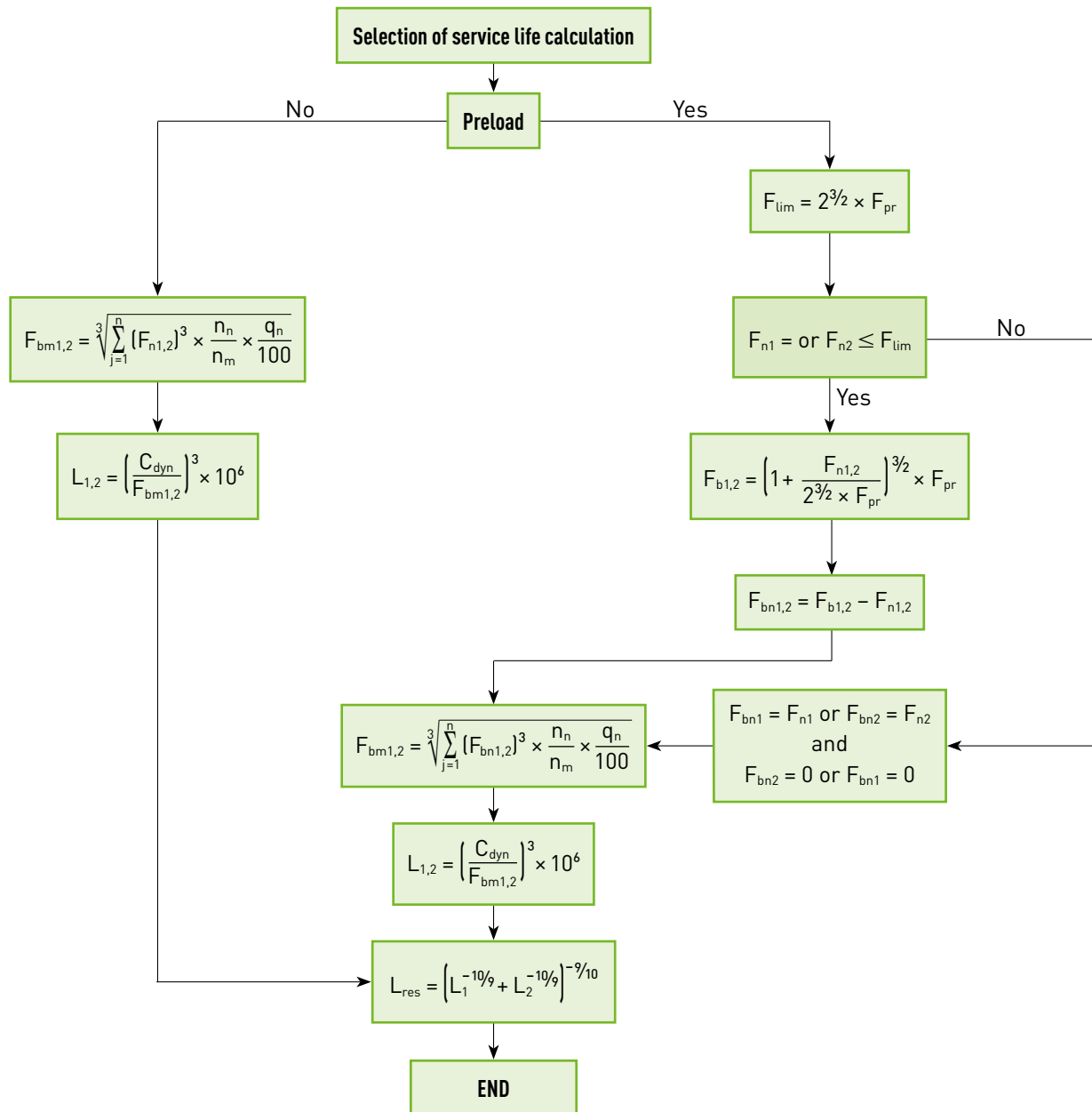
Table 2.12 **Reliability factor for calculating service life**

Resilience %	$f_r$
90	1
95	0,63
96	0,53
97	0,44
98	0,33
99	0,21

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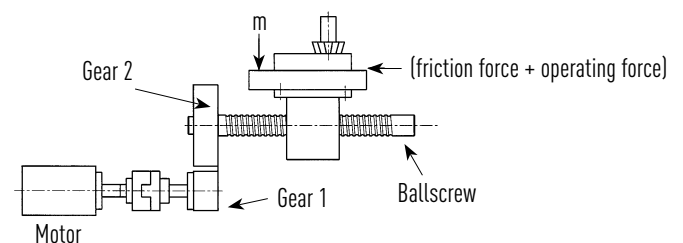
Flow chart for calculating service life



### 2.5.2 Drive torque and drive output of motor

Fig. 2.19 shows the influencing parameters of a feed system with ballscrew. Below you will find the formula for calculating the drive torque required of the motor:

Fig. 2.19 Load trend of a system with ballscrew



- Normal operation (conversion of rotary motion into linear motion)

**F 2.13**

$$T_a = \frac{F_w \times P}{2.000 \times \pi \times \eta_1}$$

- Reverse operation (conversion of linear motion into rotary motion)

**F 2.14**

$$T_c = \frac{F_w \times P \times \eta_2}{2.000 \times \pi}$$

- Drive torque of motor

For normal operation:

**F 2.15**

$$T_M = (T_a + T_b + T_d) \frac{N_1}{N_2}$$

For acceleration:

**F 2.16**

$$T'_a = J \times \alpha$$

**F 2.17**

$$\alpha = \frac{2\pi \times \Delta n}{60 \times t_a}$$

**F 2.18**

$$\Delta n = n_2 - n_1$$

**F 2.19**

$$J = J_M + J_{G1} + J_{G2} \times \left(\frac{N_1}{N_2}\right)^2 + \frac{1}{2} m_r \times \left(\frac{d_n}{2000}\right)^2 \times \left(\frac{N_1}{N_2}\right)^2 + m_l \times \left(\frac{P}{2000\pi}\right)^2 \times \left(\frac{N_1}{N_2}\right)^2$$

= motor inertia + equivalent gear inertia + inertia of ballscrew (Fig. 2.19)

Total drive torque:

**F 2.20**

$$T_{Ma} = T_M + T'_a$$

$T_a$	Drive torque for normal operation [Nm]
$T_c$	Drive torque for reverse operation [Nm]
$F_w$	Effective axial load [N], friction force + operating force
$P$	Lead [mm]
$\eta_1$	Mechanical efficiency (0.85 – 0.95), Normal operation
$\eta_2$	Mechanical efficiency (0.75 – 0.85), Reverse operation

$T_M$	Motor drive torque [Nm]
$T_b$	Friction torque of support bearing [Nm]
$T_d$	Idle torque [Nm]
$N_1$	Number of teeth on driving gear wheel
$N_2$	Number of teeth on driven gear wheel

$T'_a$	Motor drive torque during acceleration [Nm]
$J$	Inertia torque of system [Nm <sup>2</sup> ]
$\alpha$	Angular acceleration [rad/s <sup>2</sup> ]
$t_a$	Acceleration start-up time [sec]
$n_1$	Initial speed [rpm]
$n_2$	Final speed [rpm]

$m_r$	Mass of rotating parts [kg]
$m_l$	Mass of components moved in linear fashion [kg]
$d_n$	Nominal diameter of ballscrew [mm]
$J_M$	Motor inertia [kgm <sup>2</sup> ]
$J_{G1}$	Inertia of drive gear [kgm <sup>2</sup> ]
$J_{G2}$	Inertia of driven gear [kgm <sup>2</sup> ]

$T_{Ma}$	Total drive torque [Nm]
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# Ballscrews

## Properties and selection

### ○ Drive output

**F 2.21**

$$P_A = \frac{T_{pmax} \times n_{max}}{9.550}$$

### ○ Acceleration time check

**F 2.22**

$$t_a = \frac{J}{T_{M1} - T_L} \times \frac{2\pi \times n_{max}}{60} \times f$$

### 2.5.3 Buckling load

**F 2.23**

$$F_k = 4,072 \times 10^5 \left( \frac{f_k \times d_k^4}{l_s^2} \right)$$

**F 2.24**

$$F_{kmax} = 0,5 \times F_k$$

### 2.5.4 Critical speed

**F 2.25**

$$n_k = 2,71 \times 10^8 \left( \frac{f_n \times d_k}{l_s^2} \right)$$

**F 2.26**

$$n_{kmax} = 0,8 \times n_k$$

$P_A$	Maximum reliable drive output [kW]
$T_{pmax}$	Maximum drive torque (safety factor $\times T_{max}$ ) [Nm]
$n_{max}$	Maximum speed [rpm]
$t_a$	Acceleration start-up time [s]
$J$	Total inertia torque [kgm <sup>2</sup> ]
$T_{M1}$	Nominal torque of motor [Nm]
$T_L$	Drive torque at nominal speed [Nm]
$f$	Safety factor = 1.5

$F_k$	Permissible load [N]
$F_{kmax}$	Max. permissible load [N]
$d_k$	Core diameter of threaded shaft [mm]
$l_s$	Unsupported shaft length [mm]
$f_k$	Factor for different types of assembly (buckling load)

Fixed bearing – fixed bearing	$f_k = 1.0$
Fixed bearing – supported bearing	$f_k = 0.5$
Supported bearing – supported bearing	$f_k = 0.25$
Fixed bearing – no bearing	$f_k = 0.0625$

$n_k$	Critical speed [rpm]
$n_{kmax}$	Max. permissible speed [rpm]
$d_k$	Core diameter of threaded shaft [mm]
$l_s$	Unsupported shaft length [mm]
$f_n$	Factor for different types of assembly (critical speed)

Fixed bearing – fixed bearing	$f_n = 1.0$
Fixed bearing – supported bearing	$f_n = 0.692$
Supported bearing – supported bearing	$f_n = 0.446$
Fixed bearing – no bearing	$f_n = 0.147$

Fig. 2.20 Buckling load for different diameters and lengths of threaded shafts

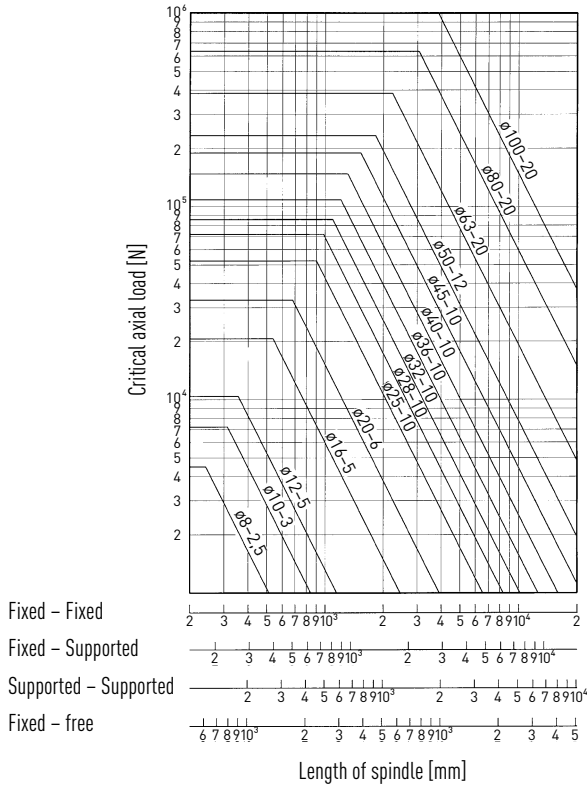
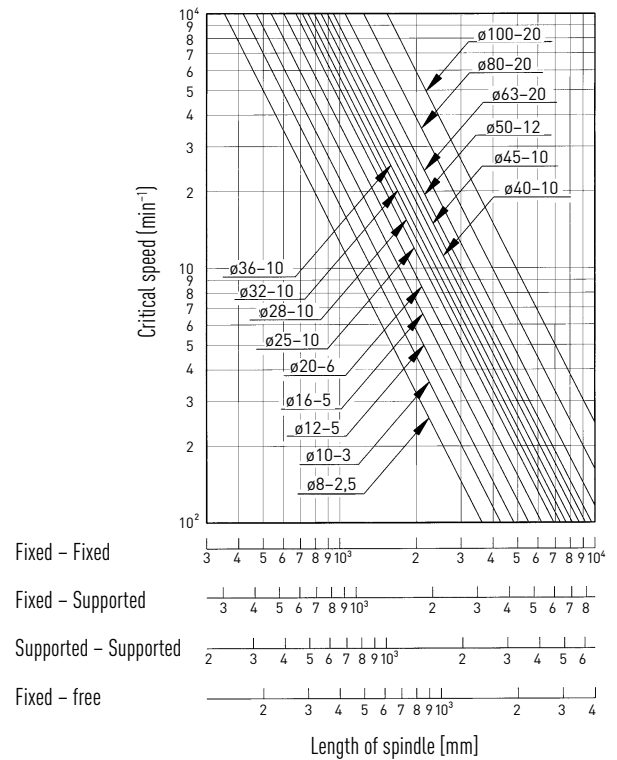


Fig. 2.21 Critical speed for different diameters and lengths of threaded shafts



### 2.5.5 $D_N$ value for working speed of a ballscrew

The specific speed value  $D_N$  has a huge influence on the behaviour of the ballscrew in terms of noise and heat development and service life of the recirculation system.

For HIWIN ballscrews

**F 2.27**  $D_N = d_s \times n_{\max}$

$D_N \leq 70\,000$  for rolled ballscrews

$D_N \leq 90\,000$  for peeled and ground ballscrews

$D_N \leq 180\,000$  for high-speed ballscrews

$d_s$  Shaft diameter [mm]  
 $n_{\max}$  Max. speed [rpm]

### 2.5.6 Rigidity

Rigidity describes the flexibility of a machine element. The overall rigidity of a ballscrew is determined by the axial rigidity of the nut/shaft system, the contact rigidity of the ball track and the rigidity of the threaded shaft. The following factors should also be taken into account when fitting the ballscrew in a machine: rigidity of support bearings, assembly conditions of nuts with table etc.

The rigidity of the nut/shaft unit and the ball and ball track can be combined to produce the rigidity of the nut  $R_n$ , which is listed in the dimensions tables for the different types of nuts.

○ Rigidity of a ballscrew

**F 2.28**  $\frac{1}{R_{bs}} = \frac{1}{R_s} + \frac{1}{R_n}$

$R_{bs}$  Overall rigidity of a ballscrew [N/μm]

# Ballscrews

## Properties and selection

### Rigidity of threaded shaft

**F 2.29**  $R_{s1} = \frac{\pi \times d_c^2 \times E}{4 \times l_1 \times 10^3}$  fixed – floating/free

**F 2.30**  $R_{s2} = \frac{\pi \times d_c^2 \times E}{4 \times l_1 \times 10^3} \times \frac{l_2}{l_2 - l_1}$  fixed – fixed

**F 2.31**  $d_c = \text{PCD} - D_k \times \cos \alpha$

$R_s$	Rigidity of threaded shaft [N/μm]
$d_c$	Diameter on which the force acts on the ballscrew shaft
$E$	Elasticity module [N/mm <sup>2</sup> ]
$\alpha$	Contact angle between ball and track [°]
PCD	Ball centre diameter of circle [mm]
$D_k$	Nominal diameter of ball [mm]
$l_1$	Distance between bearing and nut [mm]
$l_2$	Distance between bearing and bearing [mm]

### Rigidity of nut

The nut rigidity can be checked using an axial force corresponding to the maximum possible preload of 10 % of the dynamic load rating ( $C_{dyn}$ ) (this is listed in the dimensions tables for the nuts). With a lower preload, the nut rigidity can be determined by extrapolation:

**F 2.32**  $R_n = 0,8 \times R \times \left( \frac{F_{pr}}{0,1 \times C_{dyn}} \right)^{1/3}$

$R_n$	Nut rigidity [N/μm]
$R$	Rigidity in accordance with dimensions table [N/μm]
$F_{pr}$	Preload [N]
$C_{dyn}$	Dynamic load rating from dimensions table [N]

The rigidity of a single nut with play can be calculated as follows with an external axial load of  $0.28 C_{dyn}$ :

**F 2.33**  $R_n = 0,8 \times K \times \left( \frac{F_{bm}}{0,28 \times C_{dyn}} \right)^{1/3}$

The axial rigidity of a feed system includes that of the support bearing and assembly table. The total rigidity should be noted with care when configuring the system.

Fig. 2.22 Rigidity diagram for ballscrews

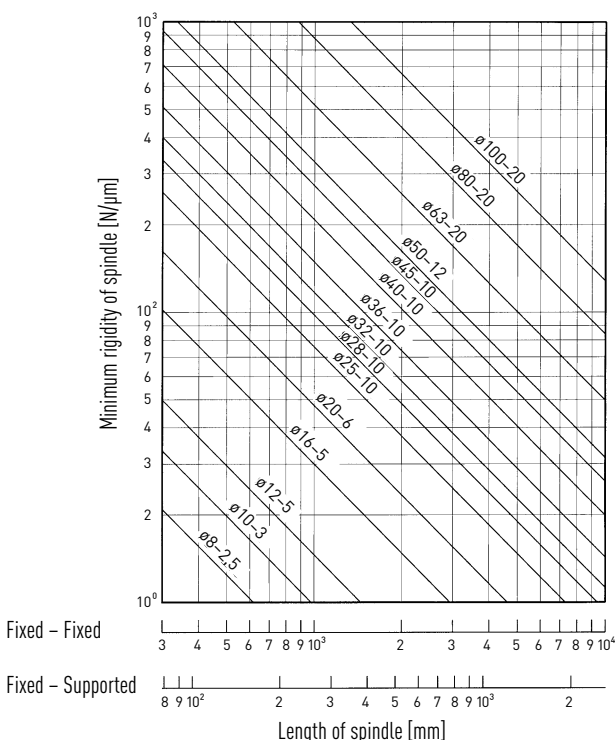
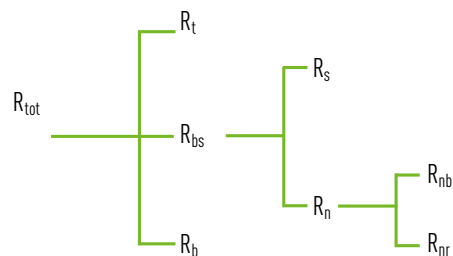


Fig. 2.23 Rigidity factors for feed systems with ballscrews



$R_{tot}$	Total rigidity of feed system
$R_t$	Rigidity of assembly table
$R_b$	Rigidity of support bearing
$R_{bs}$	Rigidity of ballscrew
$R_s$	Rigidity of threaded shaft
$R_n$	Rigidity of ballscrew nut
$R_{nb}$	Rigidity of balls and ball track
$R_{nr}$	Rigidity of nut/shaft system with radial load

## 2.5.7 Thermal expansion

**F 2.34** 
$$\Delta L = 11,6 \times 10^{-6} \times \Delta T \times L_{s,ges}$$

The T value should be selected such that the screw drive's temperature increase is compensated for. HIWIN recommends a T value of – 0.02 – 0.03/metre for CNC machine tools.

$\Delta L$  Thermal expansion of screw spindle [mm]  
 $\Delta T$  Temperature increase in screw spindle [°C]  
 $L_{s,total}$  Spindle length + shaft end (left/right) [mm]

## 2.5.8 Dynamic load rating $C_{dyn}$ (theoretical)

The dynamic load rating describes the load at which 90 % of all ballscrews reach a life expectancy of  $1 \times 10^6$  revolutions (C). The reliability factor can be taken into account in accordance with [Table 2.12](#). The dynamic load rating is listed in the dimensions tables for the nuts.

## 2.5.9 Static load rating $C_0$

The static load rating describes the load which causes permanent deformation of the ball track of more than 0.0001 of the ball diameter. In order to calculate the maximum static load rating, the static structural safety  $S_0$  of the application conditions must be taken into account.

**F 2.35** 
$$S_0 \times F_{amax} < C_0$$

$S_0$  Static structural safety  
 $C_0$  Static load rating (dimensions table for nut)  
 $F_{amax}$  Max. static axial load

## 2.5.10 Material properties

Low noise levels are needed on high-quality machine tools even when working at high rapid motion speeds and under high load. HIWIN ballscrews achieve this thanks to high-grade recirculation systems, the special design of the ball track, well-engineered assembly procedures and careful checking of surfaces and dimensions.

Table 2.13 **Material**

	Material numbers according to DIN EN 10027		
Components	Rolled ballscrews	Peeled ballscrews	Ground ballscrews
Shaft	1.1213	1.1213 1.7228	1.7228
Nut*	1.6523*		
Ball	1.3505		

\* Special nuts 16MnCr5B

## 2.5.11 Ausführungen

The maximum ballscrew length which can be manufactured depends on its diameter and accuracy ([Table 2.14](#)). Since ballscrews with a high level of accuracy require a high degree of straightness, increasing the ratio between length and diameter not only makes manufacture increasingly complicated, the shaft rigidity is also reduced. HIWIN recommends the maximum lengths listed in [Table 2.14](#). If other lengths are needed, please contact HIWIN.

# Ballscrews

## Properties and selection

Table 2.14 Maximum lengths of ballscrew shafts by outer diameter and accuracy

Outer diameter	6	8	10	12	16	20	25	28	32	36	40	45	50	55	63	80	100
HIWIN tolerance class	Maximum lengths of ballscrew shafts																
T0	110	170	300	400	600	700	1000	1000	1200	1300	1500	1600	1800	2000	2000	2000	2000
T1	110	170	400	500	720	950	1300	1500	1800	1800	2300	2500	3100	3500	4000	4000	4000
T2	140	200	500	630	900	1300	1700	1800	2200	2200	2900	3200	4000	5000	5200	6300	6300
T3	170	250	500	630	1000	1400	1800	2000	2500	3200	3500	4000	4500	5000	6000	10000	10000
T4	170	250	500	630	1000	1400	1800	2000	2500	3200	3500	4000	4500	5000	6000	10000	10000
T5	170	250	500	630	1410	1700	2400	2500	3000	3200	3800	4000	5000	5500	6900	10000	10000
T6	400	800	1000	1200	1500	1800	2500	3000	3000	4000	4000	4000	5600	5600	6900	10000	10000
T7	400	800	1000	1200	3000	3000	4000	4000	4500	4500	5600	5600	5600	5600	6900	10000	10000

Unit: mm

Green fields = Please contact HIWIN

### 2.5.12 Heat treatment

Table 2.15 shows the hardness of each of the components used in HIWIN ballscrews. The surface hardness of the ballscrew affects both the dynamic and the static load rating. The dynamic and static load ratings listed in the dimensions tables are based on a surface hardness equivalent to HRC 60. For surface hardnesses of less than this, the load ratings can be determined using the following calculation.

#### F 2.36

$$C'_0 = C_0 \times f_{H0} \quad f_{H0} = \left( \frac{\text{real hardness (HRC)}}{60} \right)^3 \leq 1$$

With hardness levels  $f_H$  and  $f_{H0}$

$C'_0$  Corrected static load rating

$C_0$  Static load rating at 60 HRC

#### F 2.37

$$C' = C_{dyn} \times f_H \quad f_H = \left( \frac{\text{real hardness (HRC)}}{60} \right)^2 \leq 1$$

$C'$  Corrected dynamic load rating

$C_{dyn}$  Dynamic load rating at 60 HRC

Table 2.15 Hardness levels of components used for HIWIN ballscrews

Components	Hardening method	Hardness (HRC)
Spindle	Carburizing or induction hardening	58 – 62
Nut	Carburizing	58 – 62
Ball		62 – 66

### 2.6 Effects of temperature increases

An increase in temperature in ballscrew shafts during operation impacts on the accuracy of a machine's feed system, especially if the machine has strict speed and accuracy requirements.

The following factors affect the temperature increase in ballscrews:

- 1) Preload
- 2) Lubrication
- 3) Stretching of the shaft

Fig. 2.24 shows the relationship between operating speed, preload and temperature increase. Fig. 2.25 shows the temperature increase in the nut depending on idle torque. According to Fig. 2.24 and Fig. 2.25, doubling the preload produces a temperature increase of around 5 °C, but only increases the rigidity by around 5 %, i.e. just a few µm.



### 2.6.1 Effects of preload

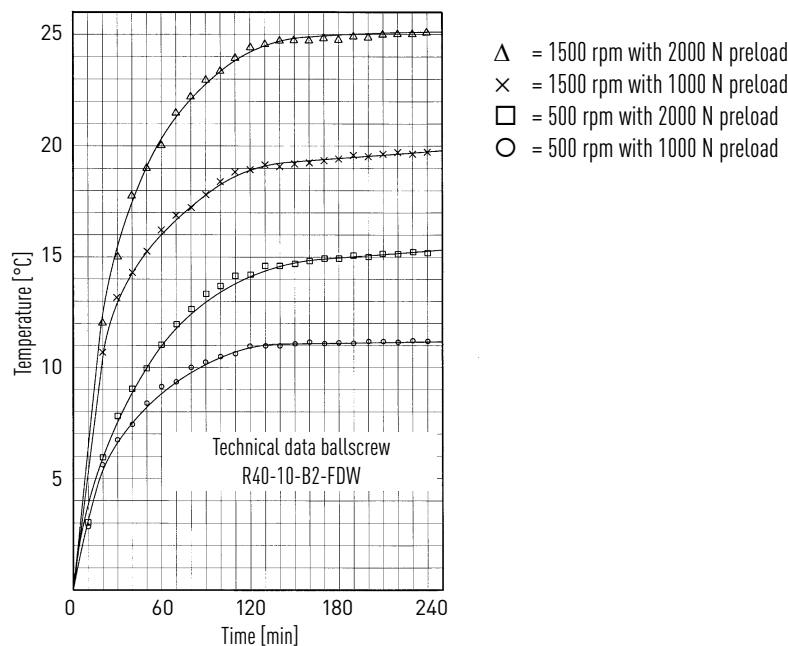
An increase in the rigidity of the ballscrew nut is important for avoiding any idling in the feed system. Despite this, it is important that the nut is only preloaded to a certain level if preload is used to increase rigidity.

Preload increases the thread's friction torque and therefore causes increases in temperature during operation.

HIWIN recommends a preload of 8 % of the dynamic load rating for medium and high preload, 6 – 8 % for medium preload, 4 – 6 % for slight to medium preload and less than 4 % for slight preload.

To ensure a long service life and low increase in temperature, the maximum preload should not exceed 10 % of the dynamic load rating.

Fig. 2.24 Relationship between operating speed, preload and temperature increase



### 2.6.2 Effects of thermal expansion

An increase in temperature in the ballscrew results in the threaded shaft expanding as a result of thermal loading. The shaft length may therefore vary. If you require more information about this, please contact HIWIN.

## 2.7 Lubrication

HIWIN ballscrews can be lubricated with grease, semi-fluid grease or oil depending on the application. They are supplied preserved as standard, but must never be taken into service without basic lubrication. For information about the initial greasing, amounts of lubricant and lubrication intervals, please consult the separate documentation "Lubrication instructions for linear guideways and ballscrews".

### Lubricant recommendations

The choice of lubricant basically depends on operating temperature and various operating factors, such as level of loading, oscillations, vibrations or short-stroke applications. Special requirements, such as use in conjunction with strong or aggressive media applications, in clean rooms, in a vacuum or in the food industry are also taken into consideration. For recommended lubricants, please refer to the "Lubrication instructions for guideways and ballscrews".

Check the miscibility of different lubricants in advance.

For grease lubrication we recommend greases according to DIN 51825 of the NLGI 2 consistency class defined in DIN 51818. Standard greases designated "– K1K" are sufficient for normal loads. Higher loading ( $P/C < 15$ ) requires high-pressure greases: "– KP1K". Other consistency classes can be used following consultation with the lubricant manufacturer.

Greases containing solid lubricants such as graphite or  $\text{MOS}_2$  must not be used.

The benefits of lubricating oils include more even distribution and better access to contact points. This does however mean that lubricating oils collect in the lower part of the product due to the force of gravity and get dirty more quickly. Larger amounts of oil are therefore needed than grease. Oil lubrication is usually only suited to use with central lubrication units or products fitted with a lubrication unit.

# Kugelgewindetriebe

## Properties and selection/rolled ballscrews

Fig. 2.25 Relationship between temperature increase in the ballscrew and idle torque

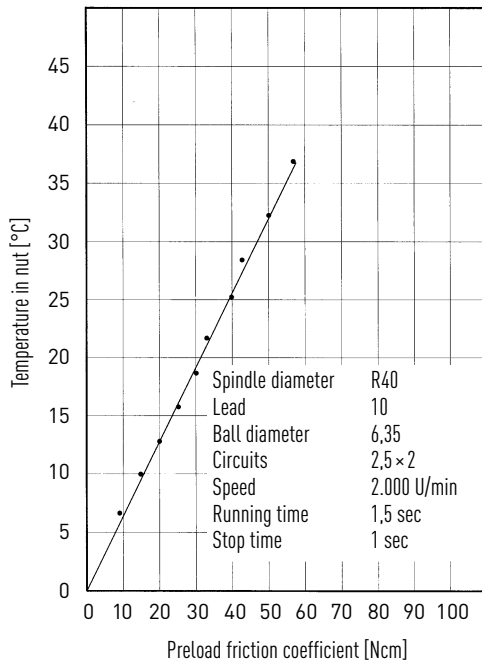


Fig. 2.26 Influence of lubricant viscosity on friction torque

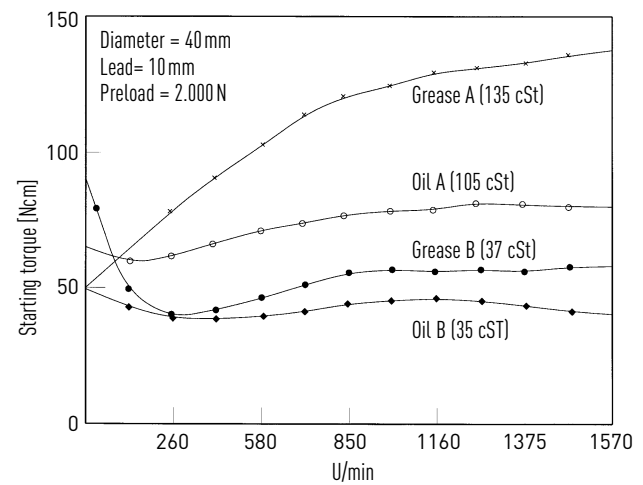


Table 2.16 Information about checking and topping up lubricant

Lubrication method	Information about checking
<b>Oil</b>	Check oil level once a week and check oil for contamination If contaminated, we recommend changing the oil
<b>Grease</b>	Check grease for contamination every two to three months If contaminated, replace old grease with new grease Always replace grease on an annual basis

### 3. Rolled ballscrews

#### 3.1 Properties

One of the benefits of rolled ballscrews is that feed systems equipped with them have less friction and are quieter than standard threads.

HIWIN manufactures them using state-of-the-art rolling technologies where the processes of material selection, rolling, heat treatment, machining and assembly are very closely coordinated.

Rolled ballscrews from HIWIN can be flexibly used in virtually all areas of industry. Rolled ballscrew shafts with diameters of 8 mm to 63 mm are always kept in stock and can be supplied at short notice. They can be supplied with or without end machining. Complete bearing units combined with standardised shaft ends enable us to supply complete ballscrews.

#### 3.2 Tolerance classes

Table 3.1 shows the tolerance classes of rolled ballscrews. The lead accuracy is defined using the deviation from nominal path over any 300 mm section of the entire length.

$$\text{Limit deviation } e_p = \pm \frac{l_u}{300} \cdot V_{300p}$$

$l_u$  Useful path

$V_{300p}$  Permissible path deviation over 300 mm travel

Table 3.1 Toleranzklassen der gerollten Kugelgewindetriebe

Path deviation	T5	T7	T10
$V_{300p}$	0.023	0.052	0.21

Einheit: mm

Table 3.2 Übersicht der lieferbaren gerollten Kugelgewindetriebe

Nominal diameter	Lead																	Max. spindle length
	1	1,25	2	2,5	3	4	5	5,08	6	8	10	12	16	20	25	32	40	
6	○	○																500
8	○		○	○ x	○		○											800
10			○	○ x	○	○ x	○		○		○							1500
12			○	○	○	○ x	○	○		○	○	○						1500
15											○			○				1500
16	○		○	○		○	○ x	○	○	○	○ x	○	○ x			○		3000
20				○		○	○ x	○	○	○	○ x			○ x			○	3000
25				○		○	○ x	○	○	○	○ x				○ x			4500
32						○	○ x	○	○	○	○ x			○		○ x	○	4500
36							○		○	○	○	○		○				4500
40							○ x		○	○	○ x	○	○	○	○		○ x	4500
50							○ x		○		○ x	○	○	○			○ x	5600
63											○	○	○	○			○	5600

Unit: mm

○ Right-hand and left-hand thread

○ Only right-hand thread

x Preferred type for right-hand thread with fast delivery

#### 3.3 Nuts for rolled ballscrews

The ballscrews listed below are available ex stock in tolerance class T7 and therefore have a short delivery time. Nut types deviating from the standard, double nuts for

rolled ballscrews and deviating tolerance classes can be ordered and supplied. Contact HIWIN staff for more details.

# Ballscrews

## Rolled

Flange single nut FSC DIN (DIN 69051 Part 5) with total recirculation

Flange single nut FSI DIN (DIN 69051 Part 5) with single recirculation

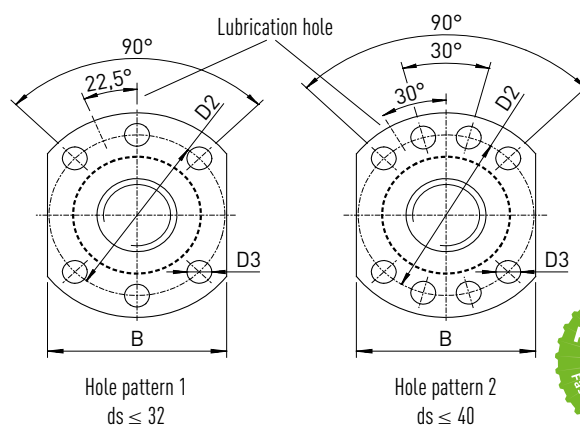
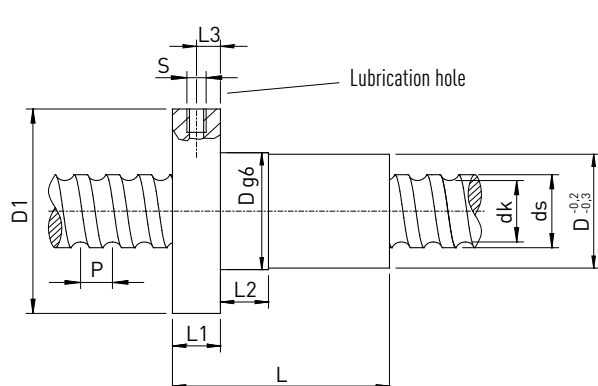


Table 3.3 Nut dimensions

Article number	ds ± 0.1	P	D g6	D1	D2	D3	Hole pattern	L	L1	L2	L3	S	B	dk	C <sub>dyn</sub> [N]	C <sub>0</sub> [N]	Axial play max. [mm]	Mass [kg/item]
R15-05K4-FSCDIN	13.8	5	28	48	38	5.5	1	38	10	10	5	M6	40	11.8	12600	21000	0.04	0.17
R16-05T3-FSIDIN	15.5	5	28	48	38	5.5	1	40	10	10	5	M6	40	12.9	7320	12470	0.04	0.17
R16-10K3-FSCDIN	14.6	10	28	48	38	5.5	1	45	10	10	5	M6	40	12.5	9100	19300	0.04	0.19
R16-16K3-FSCDIN	14.4	16	28	48	38	5.5	1	61	12	20	6	M6	40	13.0	9100	19300	0.04	0.30
R20-05K4-FSCDIN	19.5	5	36	58	47	6.6	1	40	10	10	5	M6	44	16.9	13400	32740	0.04	0.29
R20-10K3-FSCDIN	19.3	10	36	58	47	6.6	1	48	10	10	5	M6	44	16.6	10000	23500	0.04	0.32
R20-20K2-FSCDIN	19.5	20	36	58	47	6.6	1	57	10	10	5	M6	44	17.1	6800	15300	0.04	0.36
R20-20K4-DFSCDIN	19.5	20	36	58	47	6.6	1	57	10	10	5	M6	44	17.1	12300	30500	0.04	0.36
R25-05K4-FSCDIN	24.9	5	40	62	51	6.6	1	43	10	12	5	M6	48	22.3	14900	41500	0.04	0.31
R25-10K4-FSCDIN	24.4	10	40	62	51	6.6	1	61	10	16	5	M6	48	21.8	16100	40400	0.04	0.39
R25-25K2-FSCDIN	24.7	25	40	62	51	6.6	1	70	10	16	5	M6	48	22.1	7400	19100	0.04	0.43
R25-25K4-DFSCDIN	24.7	25	40	62	51	6.6	1	70	10	16	5	M6	48	22.1	13500	38200	0.04	0.43
R32-05K6-FSCDIN	31.7	5	50	80	65	9	1	48	12	10	6	M6	62	29.1	23900	81900	0.04	0.59
R32-10K5-FSCDIN	31.8	10	50	80	65	9	1	77	12	16	6	M6	62	28.6	31500	80100	0.04	1.02
R32-20K3-FSCDIN	31.8	20	50	80	65	9	1	88	12	16	7	M6	62	28.6	17000	48500	0.04	1.02
R32-32K2-FSCDIN	31.9	32	50	80	65	9	1	88	12	20	6	M6	62	28.7	11600	31800	0.04	1.20
R32-32K4-DFSCDIN	31.9	32	50	80	65	9	1	88	12	20	6	M6	62	28.7	20600	62200	0.04	1.33
R40-05K6-FSCDIN	39.4	5	63	93	78	9	2	50	14	10	7	M8 × 1	70	36.8	25900	100600	0.04	1.10
R40-10K4-FSCDIN	37.8	10	63	93	78	9	2	70	14	16	7	M8 × 1	70	32.8	45000	123000	0.04	1.25
R40-20K3-FSCDIN	37.8	20	63	93	78	9	2	88	14	16	7	M8 × 1	70	32.8	34850	90000	0.07	1.45
R40-40K2-FSCDIN	37.8	40	63	93	78	9	2	102	14	16	7	M8 × 1	70	32.9	23000	58400	0.07	1.60
R40-40K4-DFSCDIN	37.8	40	63	93	78	9	2	102	14	16	7	M8 × 1	70	32.9	41500	115800	0.07	1.60
R50-05K6-FSCDIN	49.3	5	75	110	93	11	2	50	16	10	8	M8 × 1	85	46.8	28300	127200	0.07	1.30
R50-10K6-FSCDIN	47.9	10	75	110	93	11	2	90	16	20	8	M8 × 1	85	42.9	74500	250000	0.07	2.20
R50-20K5-FSCDIN	48.0	20	75	110	93	11	2	132	18	25	9	M8 × 1	85	42.9	67200	217500	0.07	2.50
R50-40K3-FSCDIN	50.3	40	75	110	93	11	2	149	18	45	9	M8 × 1	85	45.0	39000	123000	0.07	3.30
R50-40K6-DFSCDIN	50.3	40	75	110	93	11	2	149	18	45	9	M8 × 1	85	45.0	70300	242600	0.07	3.37
R63-10T6-FSIDIN	63.1	10	90	125	108	11	2	120	18	16	9	M8 × 1	95	58.0	61920	214090	0.07	3.10

- DIN nuts for rolled ballscrew shafts
- Connecting dimensions acc. to DIN 69051 Part 5
- Nuts with NBR wiper

- Flange single nuts
- Precision ground ball tracks
- For nut housing, see chapter 7.4

- Reduced axial play on request
- FSCDIN/FSIDIN: Nut filled on one turn
- DFSCDIN: Nut filled on two turns

Order example: **R** **25** **10** **K3** **FSCDIN** **650** **730** **0,052**

### Cylindrical single nut with screw-in thread RSIT

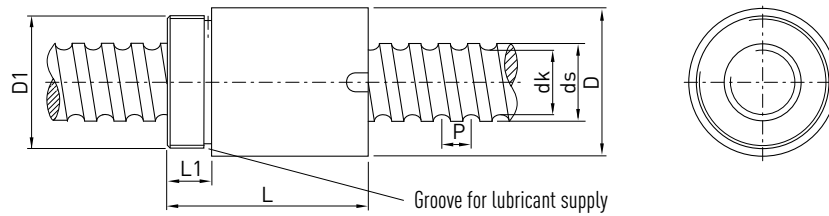


Table 3.4 Nut dimensions

Article number	ds ± 0,1	P	D -0,2	D1	L -0,5	L1	dk	Dynamic load rating C <sub>dyn</sub> [N]	Static load rating C <sub>0</sub> [N]	Axial play max. [mm]	Mass [kg/item]
<b>R08-02,5T2-RSIT**</b>	7.7	2.5	17.5	M15 × 1	27.5	7.5	6.1	1200	3360	0.04	0.04
<b>R10-02,5T2-RSIT*</b>	9.3	2.5	19.5	M17 × 1	25	7.5	8.1	1780	2630	0.04	0.06
<b>R10-04T2-RSIT*</b>	9.7	4.0	24	M22 × 1	32	10.0	7.7	1980	2820	0.04	0.08
<b>R12-04B1-RSIT**</b>	11.9	4.0	25.5	M20 × 1	34	10.0	9.5	3000	5700	0.04	0.10

\* Without dirt wiper

\*\* Polyamide wiper on one side

- Reduced axial play on request
- Nuts with dirt wipers
- Precision ground ball tracks

Order example:

<b>R</b>	<b>12</b>	<b>4</b>	<b>B1</b>	<b>RSIT</b>	<b>350</b>	<b>405</b>	<b>0,052</b>
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### Cylindrical single nut RSI

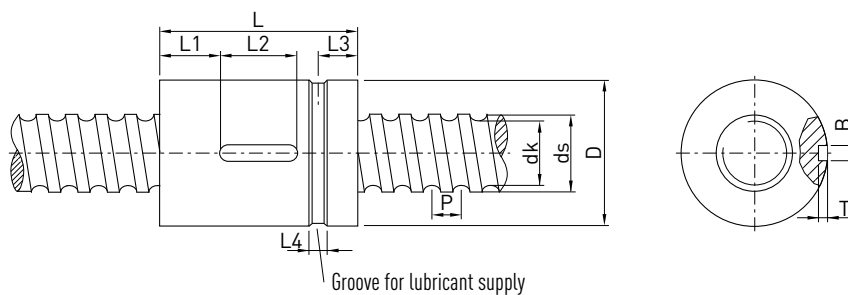


Table 3.5 Nut dimensions

Article number	ds	P	D g7	L ±0,2	L1	L2	L3	L4	T +0,1	B P9	dk	Dyn. load rating C <sub>dyn</sub> [N]	Stat load rating C <sub>0</sub> [N]	Axial play max. [mm]	Mass [kg/item]
<b>R16-10T3-RSI</b>	15,3	10	28	60	8	20	9,5	5	2,5	4	12,9	6100	10800	0,04	0,19
<b>R20-10T3-RSI</b>	19,8	10	34	60	20	20	12,0	4	2,0	5	17,5	8100	12600	0,04	0,26

- Reduced axial play on request
- Nuts with dirt wipers
- Precision ground ball tracks

Order example:

<b>R</b>	<b>16</b>	<b>10</b>	<b>T3</b>	<b>RSI</b>	<b>350</b>	<b>405</b>	<b>0,052</b>
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# Ballscrews

## Peeled

### 4. Peeled ballscrews

#### 4.1 Properties

In terms of quality, peeled ballscrews from HIWIN fall between rolled and ground ballscrews and can therefore be used for numerous transport or positioning applications. On request, we are happy to produce a lead measurement report for them. A number of nut shapes are available for peeled ballscrews, as both single and double nuts.

Customised complete ballscrews can be produced with short lead times. Complete bearing units combined with standardised shaft ends minimise the amount of design work involved.

#### 4.2 Tolerance classes

Table 4.1 shows the tolerance classes of peeled ballscrews. The lead accuracy is defined using the deviation from nominal path over any 300 mm section of the entire length.

Table 4.1 Tolerance classes of peeled ballscrews

Path deviation	Tolerance class	
	T5	T7
$V_{300p}$	0.023	0.052

Unit: mm

Table 4.2 Overview of peeled ballscrews available

Nominal diameter	Lead				Max. spindle length <sup>1)</sup>
	5	10	20	40	
16	○ ×				3300
20	○ ×				5500
25	○ ×	○ ×			5500
32	○ ×	○ ×	○ ×		6500
40	○ ×	○ ×	○ ×	○	6500
50	○ ×	○ ×	○ ×		6500
63		○ ×	○ ×		6500
80		○ ×	○ ×		6500

Unit: mm

○ Right-hand and left-hand thread

○ Only right-hand thread

× Preferred type for right-hand thread with fast delivery

<sup>1)</sup> For longer ballscrews, please contact HIWIN. The critical speed and max. compressive force should be taken into account for long shafts.

## 4.3 Nuts for peeled ballscrews

### Flange single nut DEB (DIN 69051 Part 5)

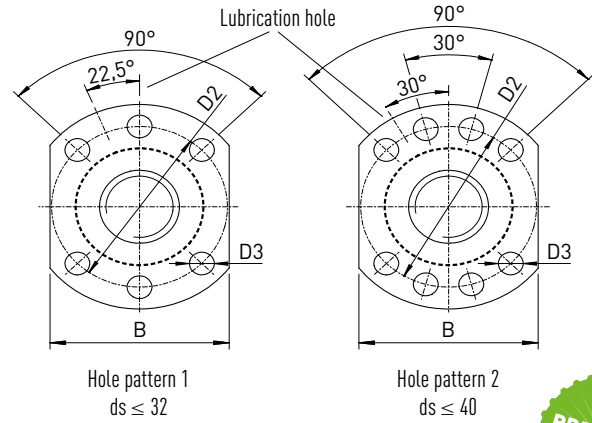
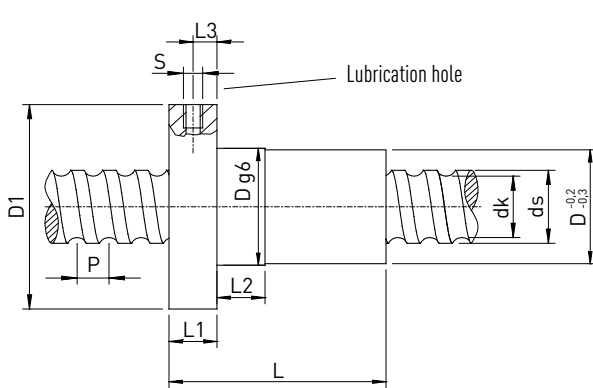


Table 4.3 Nut dimensions

Article number	ds h6	P	Dg6	D1	D2	D3	L	L1	L2	L3	S	B	dk	Dyn. load rating C <sub>dyn</sub> [N]	Stat. load rating C <sub>0</sub> [N]	Axial play max. [mm]	Mass [kg/item]
R16-05T3-DEB	16	5	28	48	38	5.5	40	10	10	5.0	M6	40	13.5	9600	12700	0.02	0.17
R20-05T4-DEB	20	5	36	58	47	6.6	52	10	10	5.0	M6	44	17.5	13900	21800	0.02	0.31
R25-05T4-DEB	25	5	40	62	51	6.6	52	10	10	5.0	M6	48	22.5	15600	27900	0.02	0.32
R25-10T3-DEB	25	10	40	62	51	6.6	65	10	16	5.0	M6	48	21.0	24100	36200	0.02	0.35
R32-05T5-DEB	32	5	50	80	65	9.0	60	12	10	6.0	M6	62	29.5	20700	43900	0.02	0.68
R32-10T4-DEB	32	10	50	80	65	9.0	85	14	16	7.0	M6	62	27.8	40900	63200	0.02	0.82
R32-20T2-DEB	32	20	50	80	65	9.0	80	14	16	7.0	M6	62	27.8	20300	26800	0.02	0.68
R40-05T5-DEB	40	5	63	93	78	9.0	69	14	10	7.0	M8 × 1	70	37.5	22500	54600	0.02	1.13
R40-10T4-DEB	40	10	63	93	78	9.0	88	14	16	7.0	M8 × 1	70	35.8	46800	82600	0.02	1.13
R40-20T2-DEB	40	20	63	93	78	9.0	88	14	16	7.0	M8 × 1	70	35.8	23800	36400	0.03	1.14
R50-05T5-DEB	50	5	75	110	93	11.0	69	16	10	8.0	M8 × 1	85	47.5	24900	69800	0.02	1.45
R50-10T4-DEB	50	10	75	110	93	11.0	98	16	16	8.0	M8 × 1	85	45.8	52800	106800	0.02	1.65
R50-20T3-DEB	50	20	75	110	93	11.0	114	16	16	8.0	M8 × 1	85	45.8	40000	76200	0.03	1.95
R63-10T6-DEB	63	10	90	125	108	11.0	120	18	16	9.0	M8 × 1	95	58.8	84700	210800	0.04	3.05
R63-20T4-DEB	63	20	95	135	115	13.5	150	20	25	10.0	M8 × 1	100	55.4	105000	250000	0.04	3.85
R63-20T5-DEB	63	20	95	135	115	13.5	175	20	25	10.0	M8 × 1	100	55.4	125000	300000	0.04	4.30
R63-20K6-DEBH	63	20	125	165	145	13.5	170	25	25	12.0	M8 × 1	130	50.2	245700	783300	0.04	13.60
R80-10T6-DEB	80	10	105	145	125	13.5	120	20	16	10.0	M8 × 1	110	75.8	93400	269200	0.04	3.20
R80-20T4-DEB	80	20	125	165	145	13.5	160	25	25	12.0	M8 × 1	130	72.4	135000	322000	0.05	8.95
R80-20T5-DEB	80	20	125	165	145	13.5	175	25	25	12.0	M8 × 1	130	72.4	161500	398000	0.05	9.25
R80-20K6-DEBH	78	20	135	175	155	13.5	170	25	25	12.5	M8 × 1	140	68.2	280000	720000	0.05	13.00
R80-20K7-DEBH	78	20	135	175	155	13.5	190	25	25	12.5	M8 × 1	140	68.2	320000	820000	0.05	14.30

- Reduced axial play on request
- DIN nuts for peeled ballscrew shafts
- Connecting dimensions according to DIN 69051 Part 5
- Nuts with dirt wipers
- Precision ground ball tracks
- Left-handed nuts on request
- For nut housing, see chapter 7.4

Order example:

R	63	10	T6	DEB	3850	3972	0,052
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# Ballscrews

## Peeled

### Flange double nut DDB (DIN 69051 Part 5)

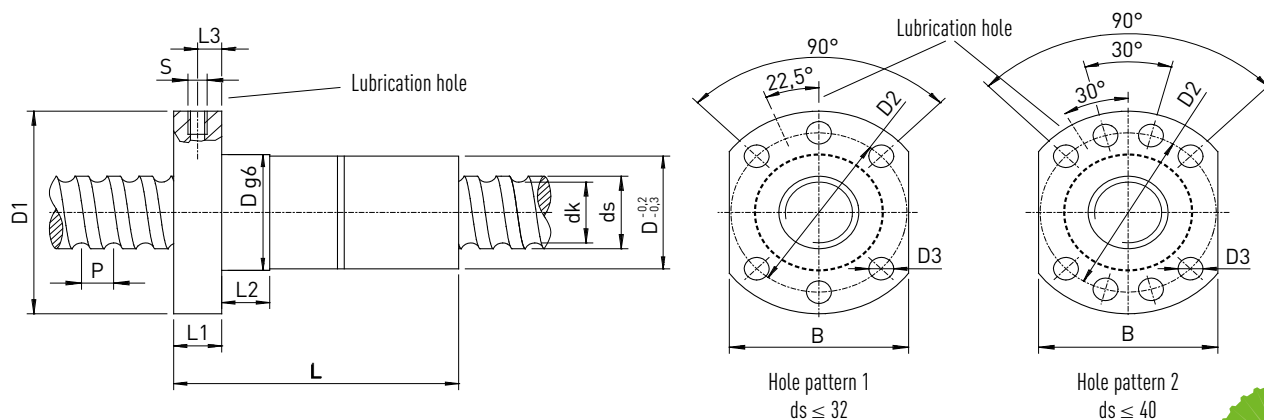


Table 4.4 Nut dimensions

Article number	ds h6	P	Dg6	D1	D2	D3	L	L1	L2	L3	S	B	dk	Dynamic load rating $C_{dyn}$ [N]	Static load rating $C_0$ [N]	Mass [kg/item]
R16-05T3-DDB	16	5	28	48	38	5.5	80	10	10	5	M6	40	13.5	9600	12700	0.36
R20-05T4-DDB	20	5	36	58	47	6.6	82	10	10	5	M6	44	17.5	13900	21800	0.45
R25-05T4-DDB	25	5	40	62	51	6.6	95	10	10	5	M6	48	22.5	15600	27900	0.55
R25-10T3-DDB	25	10	40	62	51	6.6	115	10	16	5	M6	48	21.0	24100	36200	0.60
R32-05T5-DDB	32	5	50	80	65	9.0	95	12	10	6	M6	62	29.5	20700	43900	0.97
R32-10T4-DDB	32	10	50	80	65	9.0	138	14	16	7	M6	62	27.8	40900	63200	1.03
R32-20T2-DDB	32	20	50	80	65	9.0	138	14	16	7	M6	62	27.8	20300	26800	1.02
R40-05T5-DDB	40	5	63	93	78	9.0	109	14	10	7	M8 × 1	70	37.5	22500	54600	1.55
R40-10T4-DDB	40	10	63	93	78	9.0	150	14	16	7	M8 × 1	70	35.8	46800	82600	2.15
R40-20T2-DDB	40	20	63	93	78	9.0	150	14	16	7	M8 × 1	70	35.8	23800	36400	1.80
R50-05T5-DDB	50	5	75	110	93	11.0	112	16	10	8	M8 × 1	85	47.5	24900	69800	2.16
R50-10T4-DDB	50	10	75	110	93	11.0	164	16	16	8	M8 × 1	85	45.8	52800	106800	2.50
R50-20T3-DDB	50	20	75	110	93	11.0	196	16	16	8	M8 × 1	85	45.8	40000	76200	4.34
R63-10T6-DDB	63	10	90	125	108	11.0	205	18	16	9	M8 × 1	95	58.8	84700	210800	4.40
R63-20T4-DDB	63	20	95	135	115	13.5	270	20	25	10	M8 × 1	100	55.4	105000	250000	6.95
R80-10T6-DDB	80	10	105	145	125	13.5	205	20	16	10	M8 × 1	110	75.8	93400	269200	4.75
R80-20T4-DDB	80	20	125	165	145	13.5	280	25	25	12	M8 × 1	130	72.4	135000	322000	13.85

- Reduced axial play on request
- DIN nuts for peeled ballscrew shafts
- Connecting dimensions according to DIN 69051 Part 5
- Nuts with dirt wipers
- Precision ground ball tracks
- Left-handed nuts on request
- For nut housing, see chapter 7.4

Order example:

R	63	10	T6	DDB	3850	3972	0,052
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## Cylindrical single nut ZE

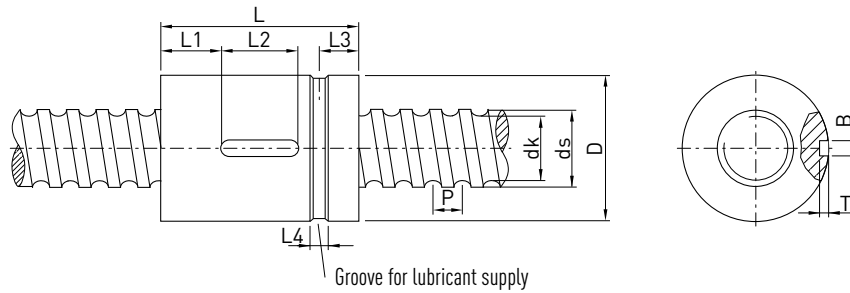


Table 4.5 Nut dimensions

Article number	ds h6	P	D g7	L ±0.2	L1	L2	L3	L4	T +0.1	B P9	dk	Dyn. load rating C <sub>dyn</sub> [N]	Stat. load rating C <sub>0</sub> [N]	Axial play max. [mm]	Mass [kg/item]
R16-05T3-ZE	16	5	28	40	12	16	9	4	2.4	4	13.5	9600	12700	0.02	0.10
R20-05T4-ZE	20	5	36	51	15	20	10	4	2.4	4	17.5	13900	21800	0.02	0.23
R25-05T4-ZE	25	5	40	60	20	20	12	5	2.4	4	22.5	15600	27900	0.02	0.29
R25-10T3-ZE	25	10	48	65	22	20	15	5	2.4	4	21.0	24100	36200	0.02	0.50
R32-05T5-ZE	32	5	48	60	20	20	12	5	2.4	4	29.5	20700	43900	0.02	0.38
R32-10T4-ZE	32	10	56	80	27	25	15	5	2.4	4	27.8	40900	63200	0.02	0.74
R32-20T2-ZE	32	20	56	80	27	25	15	5	2.4	4	27.8	20300	26800	0.02	0.70
R40-05T5-ZE	40	5	56	68	24	20	15	6	2.4	4	37.5	22500	54600	0.02	0.44
R40-10T4-ZE	40	10	62	88	31	25	15	6	2.4	4	35.8	46800	82600	0.02	0.85
R40-20T2-ZE	40	20	62	88	31	25	15	6	2.4	4	35.8	23800	36400	0.03	0.88
R50-05T5-ZE	50	5	68	69	24	20	15	6	2.4	4	47.5	24900	69800	0.02	0.72
R50-10T4-ZE	50	10	72	100	37	25	17	6	2.4	4	45.8	52800	106800	0.02	1.04
R50-20T3-ZE	50	20	72	114	44	25	17	6	2.4	4	45.8	40000	76200	0.03	1.10
R63-10T6-ZE	63	10	85	120	44	32	17	6	3.5	6	58.8	84700	210800	0.04	1.73
R63-20T4-ZE	63	20	95	135	52	32	17	6	3.5	6	55.4	105000	250000	0.04	3.80
R80-10T6-ZE	80	10	105	120	44	32	17	8	3.5	6	75.8	93400	269200	0.04	2.80
R80-20T4-ZE	80	20	125	150	52	45	17	8	3.5	6	72.4	135000	322000	0.05	7.80
R80-20T6-ZEH	78	20	130	182	68.5	45	19	8	4.0	8	68.2	200000	510000	0.05	11.05

- Reduced axial play on request
- Nuts with dirt wipers
- Precision ground ball tracks
- Left-handed nuts on request

Order example:

R	16	05	T3	ZE	420	495	0,052
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# Ballscrews

## Peeled

### 4.3.1 Cylindrical double nut ZD

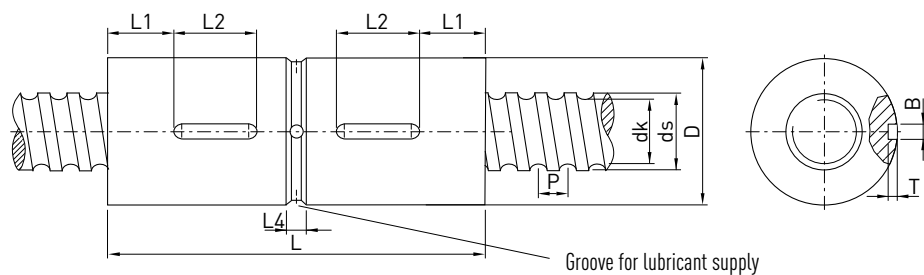


Table 4.6 Nut dimensions

Article number	ds h6	P	D g7	L	L1	L2	L4	T +0.1	B P9	dk	Dynamic load rating C <sub>dyn</sub> [N]	Static load rating C <sub>0</sub> [N]	Mass [kg/item]
R16-05T3-ZD	16	5	28	72	14	16	4	2.4	4	13.5	9600	12700	0.20
R20-05T4-ZD	20	5	36	86	15	20	4	2.4	4	17.5	13900	21800	0.39
R25-05T4-ZD	25	5	40	100	20	20	5	2.4	4	22.5	15600	27900	0.48
R25-10T3-ZD	25	10	48	115	20	20	5	2.4	4	21.0	24100	36200	0.80
R32-05T5-ZD	32	5	48	100	20	20	5	2.4	4	29.5	20700	43900	0.63
R32-10T4-ZD	32	10	56	136	25	25	6	2.4	4	27.8	32000	47500	1.30
R32-20T2-ZD	32	20	56	142	28	25	6	2.4	4	27.8	20300	26800	1.30
R40-05T5-ZD	40	5	56	108	20	20	6	2.4	4	37.5	22500	54600	0.78
R40-10T4-ZD	40	10	62	142	28	25	6	2.4	4	35.8	46500	82600	1.34
R40-20T2-ZD	40	20	62	146	30	25	6	2.4	4	35.8	23800	36400	1.51
R50-05T5-ZD	50	5	68	108	20	20	6	2.4	4	47.5	24900	69800	1.40
R50-10T4-ZD	50	10	72	168	35	25	8	2.4	4	45.8	52800	106800	1.72
R50-20T3-ZD	50	20	72	190	47	25	6	2.4	4	45.8	40000	76200	1.95
R63-10T6-ZD	63	10	85	208	44	32	6	3.5	6	58.8	84700	210800	2.81
R63-20T4-ZD	63	20	95	260	65	32	6	3.5	6	55.4	105000	250000	7.30
R80-10T6-ZD	80	10	105	208	44	32	6	3.5	6	75.8	93400	269200	5.50
R80-20T4-ZD	80	20	125	285	55	32	8	4.1	8	72.4	135000	322000	14.90

- Nuts with dirt wipers
- Precision ground ball tracks
- Left-handed nuts on request

Order example:

R	16	05	T3	ZD	420	495	0,052
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Cylindrical single nut with screw-in thread SE

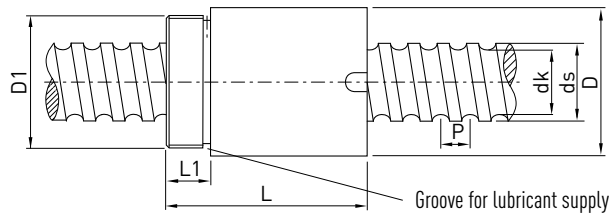


Table 4.7 Nut dimensions

Article number	ds h6	P	D -0.2	D1	L -0.5	L1	dk	Dynamic load rating C <sub>dyn</sub> [N]	Static load rating C <sub>0</sub> [N]	Axial play max. [mm]	Mass [kg/item]
R16-05T3-SE	16	5	36	M30 × 1.5	42	12	13.5	9600	12700	0.02	0.45
R20-05T4-SE	20	5	40	M35 × 1.5	52	12	17.5	13900	21800	0.02	0.53
R25-05T4-SE	25	5	45	M40 × 1.5	60	15	22.5	15600	27900	0.02	0.82
R25-10T3-SE	25	10	48	M45 × 1.5	70	15	21.0	24100	36200	0.02	1.00
R32-05T5-SE	32	5	52	M48 × 1.5	60	15	29.5	20700	43900	0.02	1.13
R32-10T3-SE	32	10	56	M52 × 1.5	80	15	27.8	34100	56100	0.02	1.62
R32-20T2-SE	32	20	56	M52 × 1.5	80	15	27.8	20300	26800	0.02	1.44
R40-05T5-SE	40	5	65	M60 × 1.5	68	18	37.5	22500	54600	0.02	1.63
R40-10T4-SE	40	10	65	M60 × 1.5	88	18	35.8	46800	82600	0.02	1.75
R40-20T2-SE	40	20	65	M60 × 1.5	88	18	35.8	23800	36400	0.03	1.75
R50-10T4-SE	50	10	80	M75 × 1.5	100	20	45.8	52800	106800	0.02	2.96
R50-20T3-SE	50	20	80	M75 × 1.5	114	20	45.8	40000	76200	0.03	3.15
R63-10T6-SE	63	10	95	M85 × 2.0	120	20	58.8	84700	210800	0.04	4.37
R63-20T3-SE	63	20	95	M85 × 2.0	138	20	55.4	96000	189000	0.04	4.40

- Reduced axial play on request
- Nuts with dirt wipers
- Precision ground ball tracks
- Left-handed nuts on request

Order example:

R	20	05	T4	SE	600	680	0,052
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# Ballscrews

## Peeled

### Safety nut SEM

The safety nut comprises a ball thread unit and safety unit. The safety nut basically works like a normal ballscrew nut. If the axial backlash is increased due to wear, ball failure or ball loss, the thread of the safety unit comes into contact with the ball thread. The nut cannot therefore break out. The normal function of the unit is guaranteed up to an axial backlash of 0.4 mm.

#### Areas of application:

- Lifting equipment
- Clamping fixtures
- Lifting platforms
- Elevators

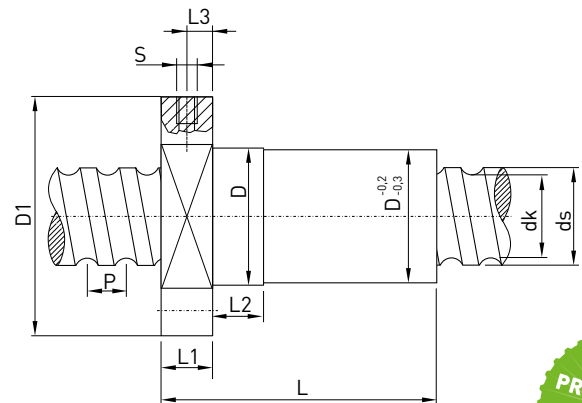
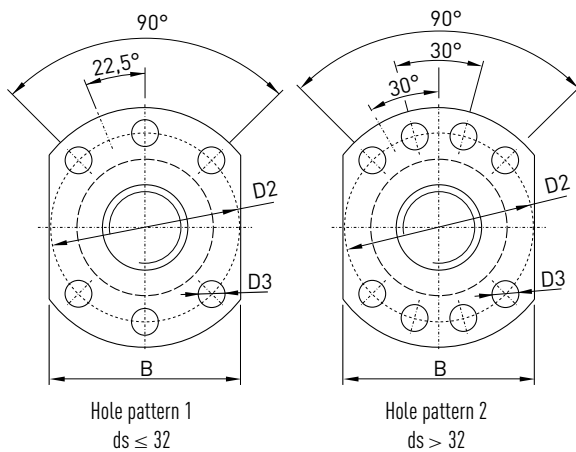
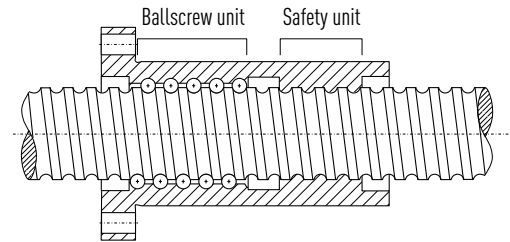


Table 4.8 Safety nut dimensions

Article number	ds h6	P	D g7	D1	D2	D3	Hole pat- tern	L	L1	L2	L3	S	L4	dk	Dynamic load rating C <sub>dyn</sub> [N]	Static load rating C <sub>0</sub> [N]
<b>R32-10T4-SEM</b>	32	10	56	86	70	9.0	1	130	15	16	7.5	M6	66	27.8	40900	63200
<b>R40-10T4-SEM</b>	40	10	63	93	78	9.0	2	130	15	16	7.5	M8 × 1	70	35.8	46800	82500
<b>R40-20T2-SEM</b>	40	20	63	93	78	9.0	2	140	15	16	7.5	M8 × 1	70	35.8	23800	36400
<b>R50-10T5-SEM</b>	50	10	75	110	93	11.0	2	145	16	16	8.0	M8 × 1	85	45.8	63900	133300
<b>R63-20T4-SEM</b>	63	20	95	135	115	13.5	2	205	20	25	10.0	M8 × 1	100	55.4	105000	250000
<b>R80-20T5-SEM</b>	80	20	125	165	145	13.5	2	230	25	25	12.5	M8 × 1	130	72.4	161500	398000

\* Simply using a safety nut does not provide sufficient protection against a load being lowered unintentionally. The safety guidelines valid for the application must be observed. Other measures, such as monitoring the motor current and the driveline, should be in place.

## 5. Ground ballscrews

### 5.1 Properties

Of the various production methods used for ballscrews, ground ballscrews offer the greatest accuracy. Ballscrews with a lead accuracy of up to 3.5 µm/300 mm thread length can be produced by grinding after hardening. They are used mainly in machine tools, grinding machines and measuring machines.

Ground ballscrews are always customized, enabling the customer's requirements relating to nut shape, load ratings, preload method, wiper type and end machining to be met. Contact our team for more details.

Below you will find typical standardized nut shapes, nominal diameters and leads. This is just part of our range. We can provide other nut dimensions on request. An extract of the diameter/lead combinations we can supply can be found in [Table 1.1](#).

### 5.2 Tolerance classes

Table 5.1 HIWIN tolerance classes of ground ballscrews

HIWIN tolerance class		T0		T1		T2		T3		T4		T5	
e <sub>2p</sub>		3		4		6		8		8		8	
e <sub>300</sub>		3,5		6		8		12		18		23	
Thread length Parameter		E <sub>p</sub>		V <sub>up</sub>		E <sub>p</sub>		V <sub>up</sub>		E <sub>p</sub>		V <sub>up</sub>	
		above	below										
—	315	4	3,5	6	6	12	8	12	12	23	18	23	23
315	400	5	3,5	7	6	13	10	13	12	25	20	25	25
400	500	6	4	8	7	15	10	15	13	27	20	27	26
500	630	6	4	9	7	16	12	16	14	30	23	32	29
630	800	7	5	10	8	18	13	18	16	35	25	36	31
800	1000	8	6	11	9	21	15	21	17	40	27	40	34
1000	1250	9	6	13	10	24	16	24	19	46	30	47	39
1250	1600	11	7	15	11	29	18	29	22	54	35	55	44
1600	2000			18	13	35	21	35	25	65	40	65	51
2000	2500			22	15	41	24	41	29	77	46	78	59
2500	3150			26	17	50	29	50	34	93	54	96	69
3150	4000			32	21	60	35	62	41	115	65	115	82
4000	5000					72	41	76	49	140	77	140	99
5000	6300					90	50			170	93	170	119
6300	8000					110	60					210	130
8000	10000											260	145
10000	12000											320	180

Unit: µm

Table 5.2 Overview of ground ballscrews available

Outer diameter	6	8	10	12	16	20	25	32	40	50	63	80	100
Accuracy	Maximum lengths of ballscrew soindles												
T0	110	170	300	400	600	700	1000	1200	1500	1800	2000	2000	2000
T1	110	170	400	500	720	950	1300	1800	2300	3100	4000	4000	4000
T2	140	200	500	630	900	1300	1700	2200	2900	4000	5200	6300	6300
T3	170	250	500	630	1000	1400	1800	2500	3500	4500	6000	10000	10000
T4	170	250	500	630	1000	1400	1800	2500	3500	4500	6000	10000	10000
T5	170	250	500	630	1410	1700	2400	3000	3800	5000	6900	10000	10000
T6	400	800	1000	1200	1500	1800	2500	3000	4000	5600	6900	10000	10000
T7	400	800	1000	1200	3000	3000	4000	4500	5600	5600	6900	10000	10000

Unit: mm

Green fields = Please contact HIWIN

# Ballscrews

## Precision-ground

### 5.3 Nuts for ground ballscrews

#### DIN single nut FSC (DIN 69051 Part 5) with total recirculation

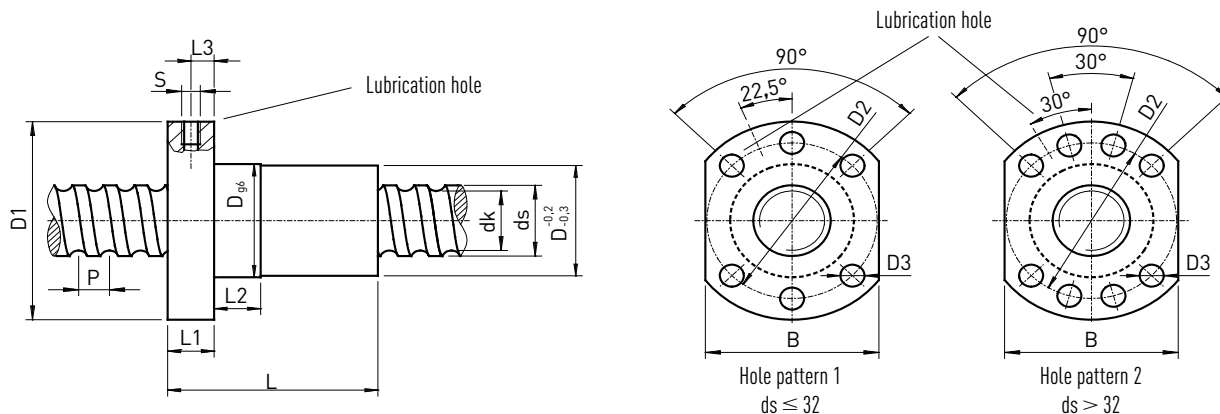


Table 5.3 Nut dimensions

Model	ds	P	Ball diameter	Dg6 min.	D1	D2	D3	Hole pattern	L	L1	L2	L3	S	B	dk	Rigidity [N/μm]	Dynamic load rating C <sub>dyn</sub> [N]	Static load rating C <sub>0</sub> [N]
R14-10K3-FSC	14	10	3.175	28	48	38	5.5	1	46	10	10	5	M5	40	10.72	240	9200	17900
R15-10K3-FSC	15	10	3.175	34 <sup>1)</sup>	57	45	5.5	1	44	10	10	5	M5	43	12.32	250	9600	19300
R15-20K2-FSC	15	20	3.175	34 <sup>1)</sup>	57	45	5.5	1	50	10	10	5	M5	43	12.32	150	6300	12560
R16-16K2-FSC	16	16	3.175	34 <sup>1)</sup>	57	45	5.5	1	47	10	10	5	M5	43	13.12	170	6800	13850
R20-05K4-FSC	20	5	3.175	36	58	47	6.6	1	40	10	10	5	M6	44	17.32	420	14900	36400
R20-10K3-FSC	20	10	3.175	36	58	47	6.6	1	47	10	10	5	M6	44	17.32	320	11300	26600
R20-20K2-FSC	20	20	3.175	36	58	47	6.6	1	57	10	10	5	M6	44	17.32	210	7600	17300
R25-05K4-FSC	25	5	3.175	40	62	51	6.6	1	43	10	10	5	M6	48	22.32	490	16500	46120
R25-10K3-FSC	25	10	3.175	40	62	51	6.6	1	50	10	10	5	M6	48	22.32	380	12600	33700
R25-10K4-FSC	25	10	3.969	45 <sup>1)</sup>	65	54	6.6	1	60	10	10	5	M6	51	21.74	560	22100	56600
R25-20K3-FSC	25	20	3.175	40	62	51	6.6	1	80	10	10	5	M6	48	22.32	390	12600	34360
R25-25K2-FSC	25	25	3.175	40	62	51	6.6	1	69	10	10	5	M6	48	22.32	250	8400	21700
R25-20K3-FSC	25	20	3.969	45 <sup>1)</sup>	65	54	6.6	1	80	10	10	5	M6	51	21.74	430	17100	42900
R32-05K4-FSC	32	5	3.175	48	70	59	6.6	1	38	12	10	6	M6	54	29.32	570	18400	59600
R32-10K5-FSC	32	10	3.969	50	80	65	9.0	1	73	12	10	6	M6	62	28.74	850	30800	94500
R32-10K5-FSC	32	10	4.763	56 <sup>1)</sup>	86	71	9.0	1	79	14	10	7	M6	65	28.13	860	38500	108900
R32-10K5-FSC	32	10	6.350	62 <sup>1)</sup>	92	77	9.0	1	77	14	10	7	M6	74	26.91	900	56400	144800
R32-20K3-FSC	32	20	3.969	50	80	65	9.0	1	87	12	20	6	M6	62	28.74	520	19000	54300
R32-20K4-FSC	32	20	4.763	54 <sup>1)</sup>	86	71	9.0	1	106	14	20	7	M6	65	28.13	720	31900	89140
R32-20K4-FSC	32	20	6.350	62 <sup>1)</sup>	92	77	9.0	1	107	14	20	7	M6	74	26.91	700	42400	108540
R32-32K2-FSC	32	32	3.969	50	80	65	9.0	1	87	12	20	6	M6	62	28.74	340	12800	35300
R32-40K2-FSC	32	40	3.969	50	80	65	9.0	1	94	12	20	6	M6	62	28.74	320	12400	34400

<sup>1)</sup> Non-standard series of DIN 69051 Part 5 for high leads or of nut diameters deviating from the DIN standard

- All dimensions stated without a unit are in mm
- The rigidity values stated are determined by calculation without preload for loading of 30 % of the dynamic load rating
- Deviating nut dimensions on request
- Other diameters and leads on request
- Left-handed nuts on request

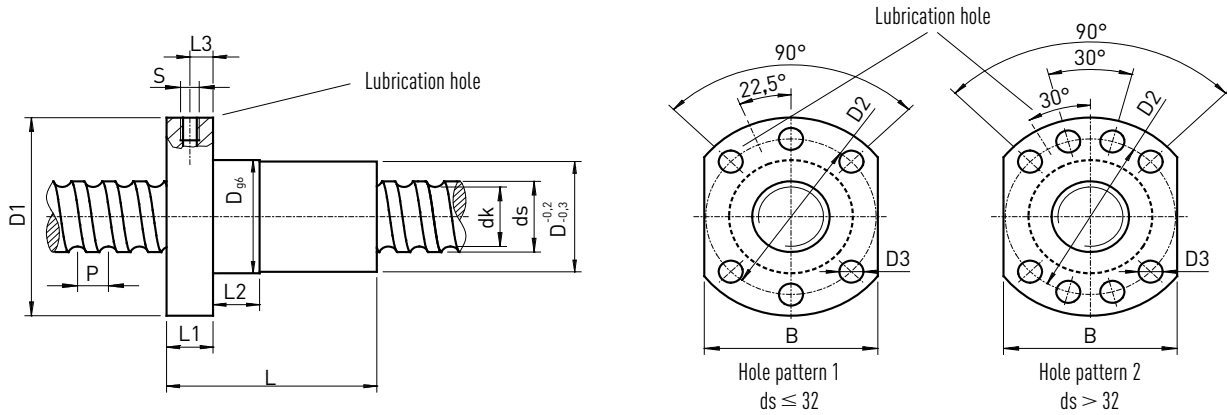


Tabelle 5.3 Nut dimensions – continued

Model	ds	P	Ball diameter	Dg6 min.	D1	D2	D3	Hole pattern	L	L1	L2	L3	S	B	dk	Rigidity [N/μm]	Dynamic load rating C <sub>dyn</sub> [N]	Static load rating C <sub>0</sub> [N]
R38-10K4-FSC	38	10	6.35	63	93	78	9.0	2	70	14	20	7	M8 × 1	70	32.91	810	50500	137900
R38-20K4-FSC	38	20	6.35	63	93	78	9.0	2	108	14	25	7	M8 × 1	70	32.91	830	49900	136600
R38-25K4-FSC	38	25	6.35	63	93	78	9.0	2	127	14	25	7	M8 × 1	70	32.91	830	49400	135600
R38-40K2-FSC	38	40	6.35	63	93	78	9.0	2	103	14	25	7	M8 × 1	70	32.91	400	25900	65600
R40-05K5-FSC	40	5	3.175	63	93	78	9.0	2	45	14	20	7	M8 × 1	70	37.32	850	24700	94900
R40-10K5-FSC	40	10	6.35	70 <sup>1)</sup>	100	85	9.0	2	83	14	20	7	M8 × 1	75	34.91	1060	63400	184000
R40-20K4-FSC	40	20	6.35	70 <sup>1)</sup>	100	85	9.0	2	110	14	20	7	M8 × 1	75	34.91	870	51300	144400
R40-40K2-FSC	40	40	6.35	70 <sup>1)</sup>	100	85	9.0	2	101	14	25	7	M8 × 1	75	34.91	420	26600	69400
R50-05K5-FSC	50	5	3.175	70	100	85	11.0	2	45	16	20	8	M8 × 1	75	47.32	950	27000	119400
R50-10K5-FSC	50	10	6.35	82 <sup>1)</sup>	118	100	11.0	2	80	16	25	8	M8 × 1	92	44.91	1250	70500	233000
R50-20K4-FSC	50	20	6.35	82 <sup>1)</sup>	118	100	11.0	2	106	16	25	8	M8 × 1	92	44.91	1040	57200	183400
R50-20K4-FSC	50	20	9.525	86 <sup>1)</sup>	121	103	11.0	2	120	16	25	8	M8 × 1	95	42.47	1130	98700	274200
R50-40K3-FSC	50	40	6.35	82 <sup>1)</sup>	118	100	11.0	2	145	16	25	8	M8 × 1	92	44.91	790	43900	137500
R63-10K5-FSC	63	10	6.35	95	135	115	13.5	2	84	20	25	10	M8 × 1	100	57.91	1440	77200	291900
R63-20K5-FSC	63	20	6.35	95	135	115	13.5	2	132	20	25	10	M8 × 1	100	57.91	1570	78500	300200
R63-20K5-FSC	63	20	9.525	107	147	127	13.5	2	140	20	25	10	M8 × 1	112	55.47	1680	134300	435300
R63-40K2-FSC	63	40	6.35	95	135	115	13.5	2	110	20	25	10	M8 × 1	100	57.91	620	33100	111000
R80-10K5-FSC	80	10	6.35	110 <sup>1)</sup>	150	130	13.5	2	80	25	25	12.5	M8 × 1	115	74.91	1660	86200	379800
R80-20K4-FSC	80	20	9.525	120 <sup>1)</sup>	165	145	13.5	2	122	25	25	12.5	M8 × 1	130	72.47	1600	124000	449100

<sup>1)</sup> Non-standard series of DIN 69051 Part 5 for high leads or of nut diameters deviating from the DIN standard

- All dimensions stated without a unit are in mm
- The rigidity values stated are determined by calculation without preload for loading of 30 % of the dynamic load rating
- Deviating nut dimensions on request
- Other diameters and leads on request
- Left-handed nuts on request

Order example: **R** **40** **40** **K2** **FSC** **1200** **1295** **0,012**

# Ballscrews

## Precision-ground

DIN double nut FDC (DIN 69051 Part 5) with total recirculation

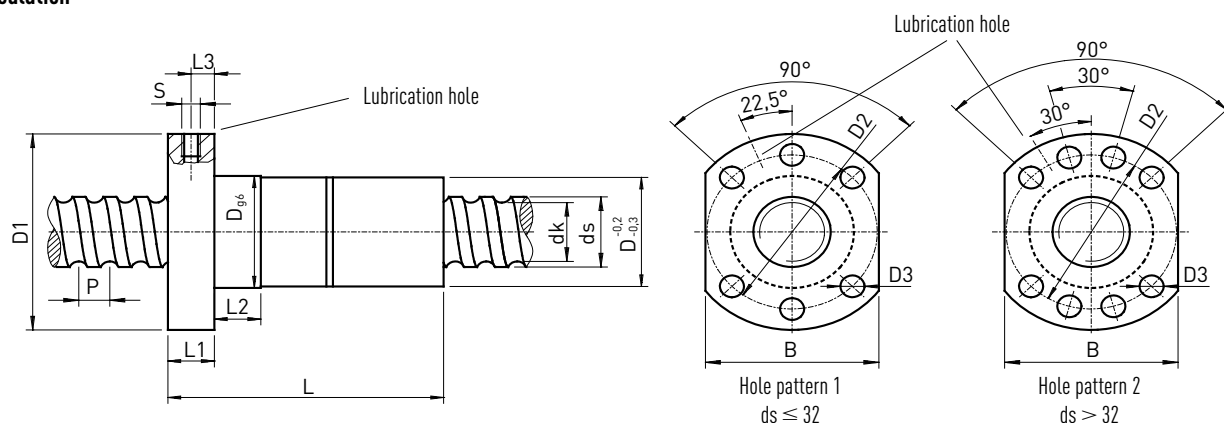


Table 5.4 Nut dimensions

Model	ds	P	Ball diameter	Dg6 min.	D1	D2	D3	Hole pattern	L	L1	L2	L3	S	B	dk	Rigidity [N/μm]	Dynamic load rating C <sub>dyn</sub> [N]	Static load rating C <sub>0</sub> [N]
R14-10K3-FDC	14	10	3.175	28	48	38	5.5	1	96	10	10	5	M5	40	10.724	310	9200	17900
R15-10K3-FDC	15	10	3.175	34 <sup>1)</sup>	57	45	5.5	1	92	10	10	5	M5	43	12.324	330	9600	19300
R15-20K2-FDC	15	20	3.175	34 <sup>1)</sup>	57	45	5.5	1	104	10	10	5	M5	43	12.324	200	6300	12560
R16-16K2-FDC	16	16	3.175	34 <sup>1)</sup>	57	45	5.5	1	98	10	10	5	M5	43	13.124	230	6800	13850
R20-05K4-FDC	20	5	3.175	36	58	47	6.6	1	84	10	10	5	M6	44	17.324	550	14900	16420
R20-10K3-FDC	20	10	3.175	36	58	47	6.6	1	98	10	10	5	M6	44	17.324	420	11300	26600
R20-20K2-FDC	20	20	3.175	36	58	47	6.6	1	116	10	10	5	M6	44	17.324	270	7600	17300
R25-05K4-FDC	25	5	3.175	40	62	51	6.6	1	90	10	10	5	M6	48	22.324	650	16500	46120
R25-10K3-FDC	25	10	3.175	40	62	51	6.6	1	104	10	10	5	M6	48	22.324	500	12600	33700
R25-10K4-FDC	25	10	3.969	45 <sup>1)</sup>	65	54	6.6	1	124	10	10	5	M6	51	21.744	740	22100	56600
R25-20K3-FDC	25	20	3.175	40	62	51	6.6	1	164	10	10	5	M6	48	22.324	510	12600	34360
R25-20K3-FDC	25	20	3.969	45 <sup>1)</sup>	65	54	6.6	1	164	10	10	5	M6	51	21.744	550	17100	42900
R25-25K2-FDC	25	25	3.175	40	62	51	6.6	1	142	10	10	5	M6	48	22.324	320	8400	21700
R32-05K4-FDC	32	5	3.175	48	70	59	6.6	1	80	12	10	6	M6	54	29.324	770	18400	59600
R32-10K5-FDC	32	10	3.969	50	80	65	9	1	150	12	10	6	M6	62	28.744	1130	30800	94500
R32-10K5-FDC	32	10	4.763	56 <sup>1)</sup>	86	71	9	1	162	14	10	7	M6	65	28.132	1130	38500	108900
R32-10K5-FDC	32	10	6.35	62 <sup>1)</sup>	92	77	9	1	158	14	10	7	M6	74	26.91	1190	56400	144800
R32-20K3-FDC	32	20	3.969	50	80	65	9	1	178	12	20	6	M6	62	28.744	680	19000	54300
R32-20K4-FDC	32	20	4.763	54 <sup>1)</sup>	86	71	9	1	216	14	20	7	M6	65	28.132	940	31900	89140
R32-20K4-FDC	32	20	6.35	62 <sup>1)</sup>	92	77	9	1	218	14	20	7	M6	74	26.91	710	42400	108540
R32-32K2-FDC	32	32	3.969	50	80	65	9	1	178	12	20	6	M6	62	28.744	440	12800	35300
R32-40K2-FDC	32	40	3.969	50	80	65	9	1	192	12	20	6	M6	62	28.744	420	12400	34400

<sup>1)</sup> Non-standard series of DIN 69051 Part 5 for high leads or of nut diameters deviating from the DIN standard

- All dimensions stated without a unit are in mm
- The rigidity values stated are determined by calculation for a preload of 10 % of the dynamic load rating
- Deviating nut dimensions on request
- Other diameters and leads on request
- Left-handed nuts on request



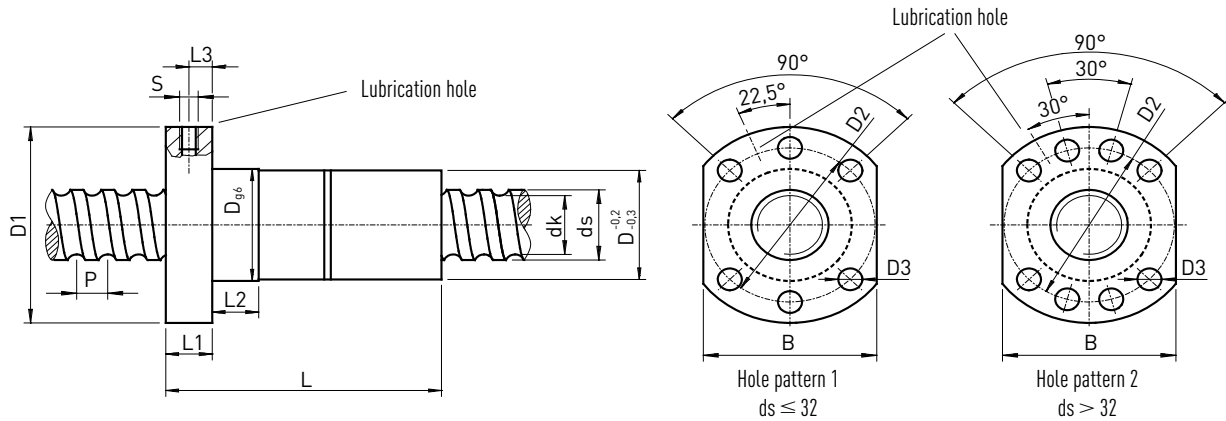


Tabelle 5.4 Nut dimensions – continued

Model	ds	P	Ball diameter	Dg6 min.	D1	D2	D3	Hole pattern	L	L1	L2	L3	S	B	dk	Rigidity [N/μm]	Dynamic load rating C <sub>dyn</sub> [N]	Static load rating C <sub>0</sub> [N]
R38-10K4-FDC	38	10	6.35	63	93	78	9	2	144	14	20	7	M8 × 1	70	32.91	1070	50500	137900
R38-20K4-FDC	38	20	6.35	63	93	78	9	2	220	14	25	7	M8 × 1	70	32.91	1100	49900	136600
R38-25K4-FDC	38	25	6.35	63	93	78	9	2	258	14	25	7	M8 × 1	70	32.91	1090	49400	135600
R38-40K2-FDC	38	40	6.35	63	93	78	9	2	210	14	25	7	M8 × 1	70	32.91	530	25900	65600
R40-05K5-FDC	40	5	3.175	63	93	78	9	2	95	14	20	7	M8 × 1	70	37.324	1140	24700	94900
R40-10K5-FDC	40	10	6.35	70 <sup>1)</sup>	100	85	9	2	171	14	20	7	M8 × 1	75	34.91	1410	63400	184000
R40-20K4-FDC	40	20	6.35	70 <sup>1)</sup>	100	85	9	2	225	14	20	7	M8 × 1	75	34.91	1150	51300	144400
R40-40K2-FDC	40	40	6.35	70 <sup>1)</sup>	100	85	9	2	207	14	25	7	M8 × 1	75	34.91	560	26600	69400
R50-05K5-FDC	50	5	3.175	70	100	85	11	2	95	16	20	8	M8 × 1	75	47.324	1290	27000	119400
R50-10K5-FDC	50	10	6.35	82 <sup>1)</sup>	118	100	11	2	166	16	25	8	M8 × 1	92	44.91	1660	70500	233000
R50-20K4-FDC	50	20	6.35	82 <sup>1)</sup>	118	100	11	2	218	16	25	8	M8 × 1	92	44.91	1380	57200	183400
R50-20K4-FDC	50	20	9.525	86 <sup>1)</sup>	121	103	11	2	245	16	25	8	M8 × 1	95	42.466	1490	98700	274200
R50-40K3-FDC	50	40	6.35	82 <sup>1)</sup>	118	100	11	2	295	16	25	8	M8 × 1	92	44.91	1040	43900	137500
R63-10K5-FDC	63	10	6.35	95	135	115	13.5	2	174	20	25	10	M8 × 1	100	57.91	1920	77200	291900
R63-20K5-FDC	63	20	6.35	95	135	115	13.5	2	270	20	25	10	M8 × 1	100	57.91	2080	78500	300200
R63-20K5-FDC	63	20	9.525	107	147	127	13.5	2	286	20	25	10	M8 × 1	112	55.466	2220	134300	435300
R63-40K2-FDC	63	40	6.35	95	135	115	13.5	2	226	20	25	10	M8 × 1	100	57.91	820	33100	111000
R80-10K5-FDC	80	10	6.35	110 <sup>1)</sup>	150	130	13.5	2	170	25	25	12.5	M8 × 1	115	74.91	2230	86200	379800
R80-20K4-FDC	80	20	9.525	120 <sup>1)</sup>	165	145	13.5	2	250	25	25	12.5	M8 × 1	130	72.466	2120	124000	449100

<sup>1)</sup> Non-standard series of DIN 69051 Part 5 for high leads or of nut diameters deviating from the DIN standard

- All dimensions stated without a unit are in mm
- The rigidity values stated are determined by calculation for a preload of 10 % of the dynamic load rating
- Deviating nut dimensions on request
- Other diameters and leads on request
- Left-handed nuts on request

Order example:

R	40	40	K2	FDC	1200	1295	0,012
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# Ballscrews

## Precision-ground

### 5.3.1 Flange single nut FSI with single recirculation

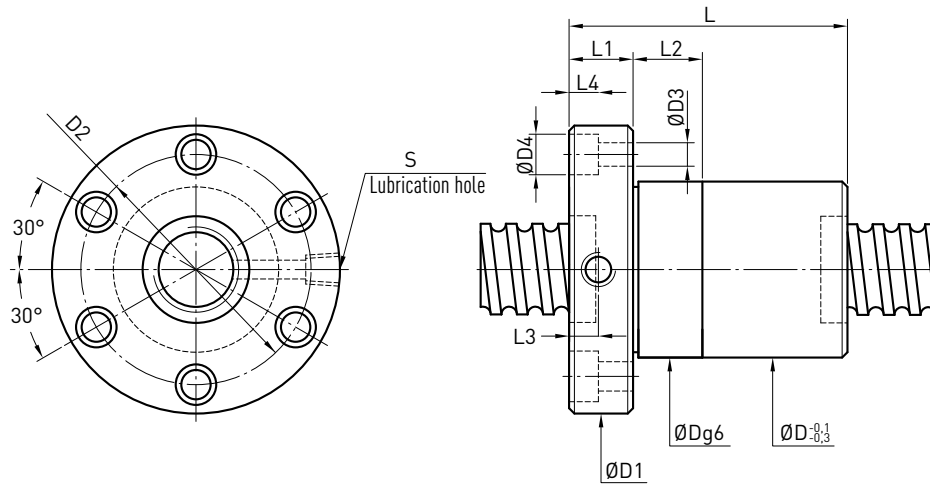


Table 5.5 Nut dimensions

Model	ds	P	Ball diameter	Dg6 min.	D1	D2	D3	D4	L	L1	L2	L3	L4	S	dk	Rigidity [N/μm]	Dynamic load rating C <sub>dyn</sub> [N]	Static load rating C <sub>0</sub> [N]	Weight [kg]
R8-2.5T3-FSI	8	2.5	1.500	18	35	27	4.5	—	28	5	—	—	—	—	6.65	80	1700	2670	0.04
R16-2T3-FSI	16	2	1.500	27	44	34	4.5	8.0	36	10	—	5.0	4.5	M6	14.65	140	2520	5930	0.17
R16-5T3-FSI	16	5	3.175	30	54	41	5.5	9.5	46	12	12	6.0	5.5	M6	13.32	110	7310	13310	0.32
R16-5T4-FSI	16	5	3.175	30	54	41	5.5	9.5	52	12	12	6.0	5.5	M6	13.32	120	9360	17750	0.34
R20-2T4-FSI	20	2	1.500	32	52	40	5.5	9.5	40	10	12	5.0	5.5	M6	18.65	360	3990	11120	0.25
R20-2T6-FSI	20	2	1.500	32	52	40	5.5	9.5	52	10	12	5.0	5.5	M6	18.65	320	5180	15510	0.29
R20-5T3-FSI	20	5	3.175	34	57	45	5.5	9.5	46	12	12	6.0	5.5	M6	17.32	200	8520	17670	0.35
R20-5T4-FSI	20	5	3.175	34	57	45	5.5	9.5	53	12	12	6.0	5.5	M6	17.32	270	10910	23560	0.38
R25-2T3-FSI	25	2	1.500	36	58	46	5.5	9.5	35	10	12	5.0	5.5	M6	23.65	200	3090	9800	0.24
R25-2T4-FSI	25	2	1.500	36	58	46	5.5	9.5	40	10	12	5.0	5.5	M6	23.65	270	3950	13070	0.26
R25-2T6-FSI	25	2	1.500	36	58	46	5.5	9.5	50	10	12	5.0	5.5	M6	23.65	390	5600	19600	0.30
R25-5T3-FSI	25	5	3.175	40	64	51	5.5	9.5	46	11	10	5.5	5.5	M6	22.32	280	9770	23140	0.42
R25-5T4-FSI	25	5	3.175	40	64	51	5.5	9.5	51	11	10	5.5	5.5	M6	22.32	370	12520	30850	0.44
R25-5T5-FSI	25	5	3.175	40	63	51	5.5	9.5	56	11	10	5.5	5.5	M6	22.32	400	15160	38560	0.47
R25-5T6-FSI	25	5	3.175	40	63	51	5.5	9.5	65	11	10	5.5	5.5	M6	22.32	480	17730	46270	0.52
R25-10T3-FSI	25	10	4.763	45	69	55	6.6	11.0	65	15	12	7.5	6.5	M6	21.13	250	15910	32360	0.80
R25-10T4-FSI	25	10	4.763	45	69	55	6.6	11.0	80	15	12	7.5	6.5	M6	21.13	330	20380	43150	0.90
R32-5T3-FSI	32	5	3.175	44	74	60	6.6	11.0	46	12	12	6.0	6.5	M6	29.32	330	11170	30810	0.49
R32-5T4-FSI	32	5	3.175	44	74	60	6.6	11.0	53	12	12	6.0	6.5	M6	29.32	420	14310	41080	0.53
R32-5T6-FSI	32	5	3.175	44	74	60	6.6	11.0	66	12	12	6.0	6.5	M6	29.32	630	20270	61620	0.59
R32-10T3-FSI	32	10	6.350	51	82	68	6.6	11.0	72	16	12	8.0	6.5	M6	26.91	350	25390	53270	1.02
R32-10T4-FSI	32	10	6.350	51	82	68	6.6	11.0	83	16	12	8.0	6.5	M6	26.91	480	32520	71020	1.11

- All dimensions stated without a unit are in mm
- The rigidity values stated are determined by calculation without preload for loading of 30 % of the dynamic load rating
- Deviating nut dimensions on request
- Other diameters and leads on request

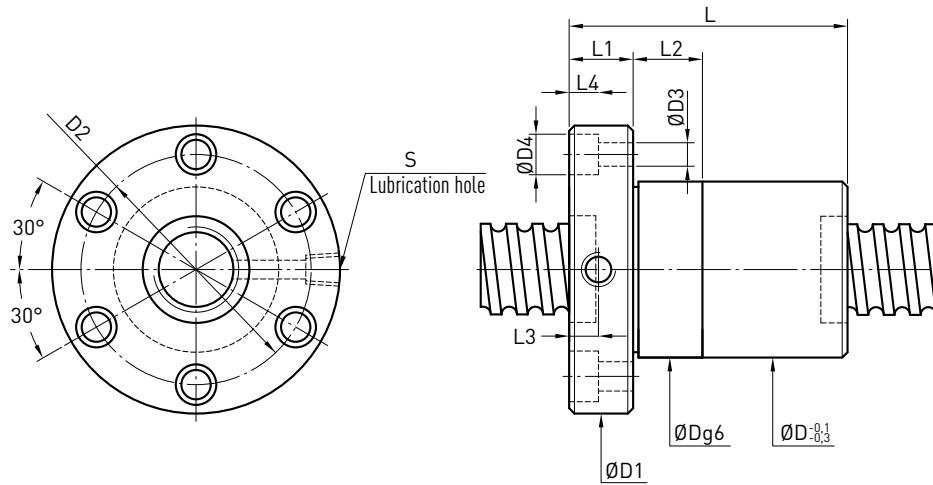


Tabelle 5.5 Nut dimensions – continued

Model	ds	P	Ball diameter	Dg6 min.	D1	D2	D3	D4	L	L1	L2	L3	L4	S	dk	Rigidity [N/µm]	Dynamic load rating C <sub>dyn</sub> [N]	Static load rating C <sub>0</sub> [N]	Weight [kg]
R40-5T4-FSI	40	5	3.175	51	80	66	6.6	11.0	53	16	12	8.0	6.5	M8 × 1	37.32	500	15990	52800	0.66
R40-5T6-FSI	40	5	3.175	51	80	66	6.6	11.0	66	16	12	8.0	6.5	M8 × 1	37.32	740	22650	79190	0.73
R40-10T3-FSI	40	10	6.350	60	96	80	9.0	14.0	76	16	15	8.0	8.5	M8 × 1	34.91	400	29590	70690	1.37
R40-10T4-FSI	40	10	6.350	60	96	80	9.0	14.0	87	16	15	8.0	8.5	M8 × 1	34.91	510	37890	94260	1.49
R50-5T4-FSI	50	5	3.175	62	96	80	9.0	14.0	57	16	15	8.0	8.5	M8 × 1	47.32	620	17570	67450	0.95
R50-5T6-FSI	50	5	3.175	62	96	80	9.0	14.0	70	16	15	8.0	8.5	M8 × 1	47.32	910	24900	10117	1.04
R50-10T3-FSI	50	10	6.350	69	114	92	11.0	17.5	78	18	20	9.0	11.0	M8 × 1	44.91	500	33970	92560	1.85
R50-10T4-FSI	50	10	6.350	69	114	92	11.0	17.5	89	18	20	9.0	11.0	M8 × 1	44.91	630	43500	123410	1.98
R50-10T6-FSI	50	10	6.350	69	114	92	11.0	17.5	112	18	20	9.0	11.0	M8 × 1	44.91	940	61650	185110	2.26
R50-20T4-FSI	50	20	9.525	75	129	105	14.0	20.0	186	28	30	14.0	13.0	M8 × 1	42.47	800	93270	239550	5.30
R63-10T4-FSI	63	10	6.350	82	134	110	14.0	20.0	91	20	20	10.0	13.0	M8 × 1	57.91	790	48600	158580	2.54
R63-10T6-FSI	63	10	6.350	82	134	110	14.0	20.0	114	20	20	10.0	13.0	M8 × 1	57.91	1150	68870	237860	2.88
R80-10T4-FSI	80	10	6.350	99	152	127	14.0	20.0	91	20	20	10.0	13.0	M8 × 1	74.91	960	55590	21118	3.00
R80-10T6-FSI	80	10	6.350	99	152	127	14.0	20.0	114	20	20	10.0	13.0	M8 × 1	74.91	1400	78790	316770	3.42
R80-20T3-FSI	80	20	9.525	108	174	143	18.0	26.0	138	24	25	12.0	17.5	M8 × 1	72.47	950	96630	316220	6.30
R80-20T4-FSI	80	20	9.525	108	174	143	18.0	26.0	161	24	25	12.0	17.5	M8 × 1	72.47	1250	123750	421620	6.96
R100-20T4-FSI	100	20	9.525	135	194	163	18.0	26.0	161	24	30	12.0	17.5	M8 × 1	92.47	1550	135690	531610	8.60

- All dimensions stated without a unit are in mm
- The rigidity values stated are determined by calculation without preload for loading of 30 % of the dynamic load rating
- Deviating nut dimensions on request
- Other diameters and leads on request

Order example:

R	50	10	T4	FSI	2250	2325	0,023
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# Ballscrews

## Precision-ground

### 5.3.2 Flange double nut FDI with single recirculation

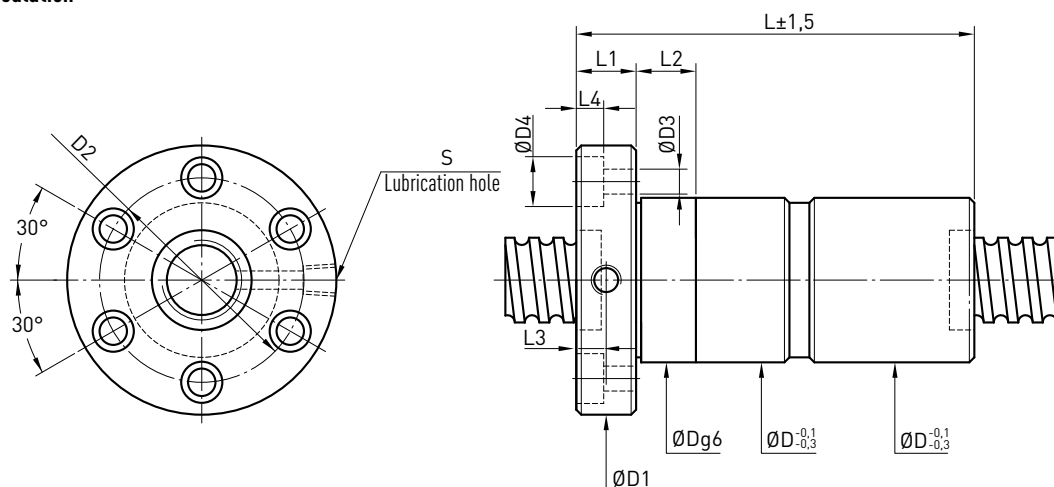


Table 5.6 Nut dimensions

Model	ds	P	Ball diameter	Dg6 min.	D1	D2	D3	D4	L	L1	L2	L3	L4	S	dk	Rigidity [N/μm]	Dynamic load rating C <sub>dyn</sub> [N]	Static load rating C <sub>0</sub> [N]	Weight [kg]
R16-5T3-FDI	16	5	3.175	30	54	41	5.5	9.5	78	12	24	6.0	5.5	M6	13.32	200	7310	13310	0.43
R16-5T4-FDI	16	5	3.175	30	54	41	5.5	9.5	90	12	24	6.0	5.5	M6	13.32	230	9360	17750	0.48
R20-5T3-FDI	20	5	3.175	34	57	45	5.5	9.5	78	12	24	6.0	5.5	M6	17.32	390	8520	17670	0.49
R20-5T4-FDI	20	5	3.175	34	57	45	5.5	9.5	92	12	24	6.0	5.5	M6	17.32	540	10910	23560	0.55
R25-5T3-FDI	25	5	3.175	40	64	52	5.5	9.5	78	12	24	5.5	5.5	M6	22.32	550	9770	23140	0.59
R25-5T4-FDI	25	5	3.175	40	64	52	5.5	9.5	96	12	24	5.5	5.5	M6	22.32	730	12520	30850	0.69
R25-10T3-FDI	25	10	4.763	51	74	60	6.6	11.0	140	15	24	7.5	6.5	M6	21.13	490	16430	32650	1.38
R32-5T3-FDI	32	5	3.175	44	74	60	6.6	11.0	78	12	24	6.0	6.5	M6	29.32	640	11170	30810	0.65
R32-5T4-FDI	32	5	3.175	44	74	60	6.6	11.0	96	12	24	6.0	6.5	M6	29.32	820	14310	41080	0.74
R32-5T6-FDI	32	5	3.175	44	74	60	6.6	11.0	118	12	24	6.0	6.5	M6	29.32	1210	20270	61620	0.85
R32-10T3-FDI	32	10	6.350	51	82	68	6.6	11.0	129	16	24	8.0	6.5	M6	26.91	680	25390	53270	1.50
R32-10T4-FDI	32	10	6.350	51	82	68	6.6	11.0	155	16	24	8.0	6.5	M6	26.91	820	32520	71020	1.72
R40-5T4-FDI	40	5	3.175	51	80	66	6.6	11.0	96	16	24	8.0	6.5	M8×1	37.32	990	15990	52800	0.89
R40-5T6-FDI	40	5	3.175	51	80	66	6.6	11.0	122	16	24	8.0	6.5	M8×1	37.32	1460	22650	79190	1.03
R40-10T3-FDI	40	10	6.350	60	96	80	9.0	14.0	133	16	30	8.0	8.5	M8×1	34.91	760	29590	70690	1.99
R40-10T4-FDI	40	10	6.350	60	96	80	9.0	14.0	155	16	30	8.0	8.5	M8×1	34.91	1010	37890	94260	2.22

- All dimensions stated without a unit are in mm
- The rigidity values stated are determined by calculation for a preload of 10 % of the dynamic load rating
- Deviating nut dimensions on request
- Other diameters and leads on request

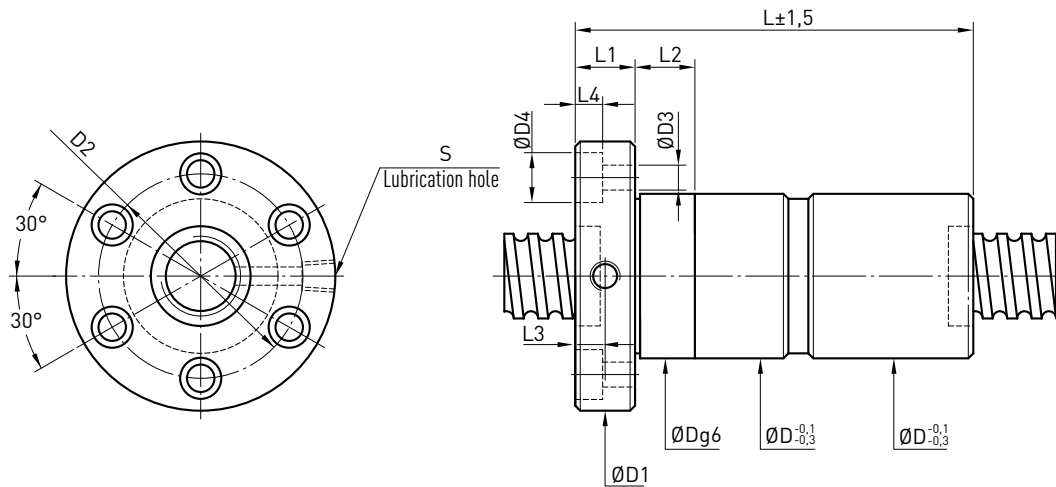


Tabelle 5.6 Nut dimensions – continued

Model	ds	P	Ball diameter	Dg6 min.	D1	D2	D3	D4	L	L1	L2	L3	L4	S	dk	Rigidity [N/μm]	Dynamic load rating $C_{dyn}$ [N]	Static load rating $C_0$ [N]	Weight [kg]
R50-5T4-FDI	50	5	3.175	62	96	80	9.0	14.0	96	16	30	8.0	8.5	M8 × 1	47.32	1210	17570	67450	1.23
R50-5T6-FDI	50	5	3.175	62	96	80	9.0	14.0	122	16	30	8.0	8.5	M8 × 1	47.32	1770	24900	101170	1.42
R50-10T3-FDI	50	10	6.350	69	114	92	11.0	17.5	135	18	40	9.0	11.0	M8 × 1	44.91	950	33970	92560	2.53
R50-10T4-FDI	50	10	6.350	69	114	92	11.0	17.5	157	18	40	9.0	11.0	M8 × 1	44.91	1240	43500	123410	2.80
R50-10T6-FDI	50	10	6.350	69	114	92	11.0	17.5	203	18	40	9.0	11.0	M8 × 1	44.91	1840	61650	185110	3.35
R63-10T4-FDI	63	10	6.350	82	134	110	14.0	20.0	159	20	40	10.0	13.0	M8 × 1	57.91	1580	48600	158580	3.53
R63-10T6-FDI	63	10	6.350	82	134	110	14.0	20.0	205	20	40	10.0	13.0	M8 × 1	57.91	2280	68870	237860	4.20
R80-10T4-FDI	80	10	6.350	99	152	127	14.0	20.0	172	20	40	10.0	13.0	M8 × 1	74.91	1900	55590	211180	4.45
R80-10T6-FDI	80	10	6.350	99	152	127	14.0	20.0	214	20	40	10.0	13.0	M8 × 1	74.91	2770	78790	316770	5.20
R80-20T3-FDI	80	20	9.525	108	174	143	18.0	26.0	250	24	50	12.0	17.5	M8 × 1	72.47	1890	96630	316220	9.54
R80-20T4-FDI	80	20	9.525	108	174	143	18.0	26.0	296	24	50	12.0	17.5	M8 × 1	72.47	2480	123750	421620	10.87
R100-20T4-FDI	100	20	9.525	135	194	163	18.0	26.0	296	24	60	12.0	17.5	M8 × 1	92.47	3000	135690	531610	12.69

- All dimensions stated without a unit are in mm
- The rigidity values stated are determined by calculation for a preload of 10 % of the dynamic load rating
- Deviating nut dimensions on request
- Other diameters and leads on request

Order example:

R	50	10	T4	FDI	2250	2325	0,023
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# Ballscrews

## Precision-ground

### 5.3.3 Cylindrical single nut RSI with single recirculation

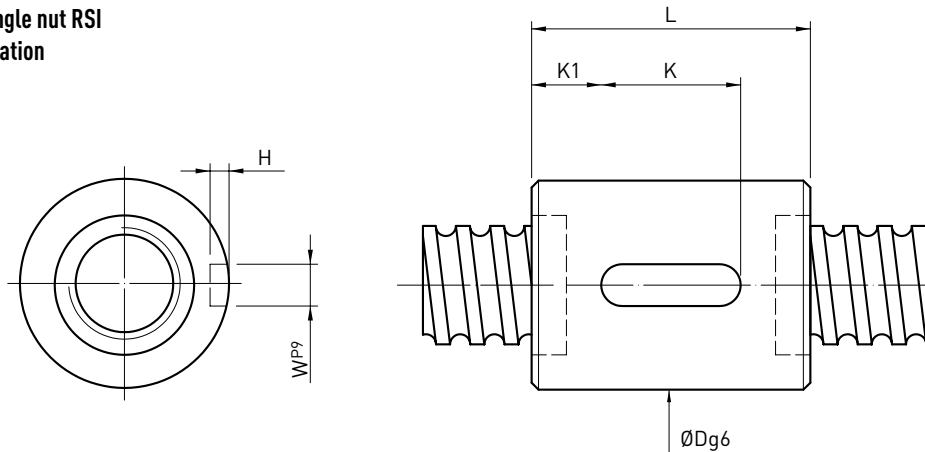


Table 5.7 Nut dimensions

Model	Size		Ball diameter	Circuits	Rigidity K [N/μm]	Dyn. load rating C <sub>dyn</sub> [N]	Static load rating C <sub>0</sub> [N]	Nut		Feather key groove				
	Nominal Ø	Lead						D	L	K	W	H	K1	
R16-2T4-RSI	16	2	1,5	4	150	1780	3950	25	25	20	3	1,8	2,5	
R16-5T3-RSI		5	3,175	3	110	7310	13310	28	30	40	20	3	1,8	10
R16-5T4-RSI				4	120	9360	17750	28	30	46	20	3	1,8	13
R20-5T3-RSI	20	5	3,175	3	200	8520	17670	32	34	41	20	3	1,8	10,5
R20-5T4-RSI				4	270	10910	23560	32	34	48	20	3	1,8	14
R25-5T3-RSI	25	5	3,175	3	280	9770	23140	37	40	41	20	4	2,5	10,5
R25-5T4-RSI				4	370	12520	30850	37	40	48	20	4	2,5	14
R32-5T3-RSI	32	5	3,175	3	330	11170	30810	44	48	41	20	4	2,5	10,5
R32-5T4-RSI				4	420	14310	41080	44	48	48	20	4	2,5	14
R32-5T6-RSI				6	630	20270	61620	44	48	61	25	4	2,5	18
R32-10T3-RSI		10	6,35	3	350	25390	53270	51	56	68	25	6	3,5	21,5
R32-10T4-RSI				4	480	32520	71020	51	56	79	32	6	3,5	23,5
R40-5T4-RSI	40	5	3,175	4	500	15990	52800	51	54	48	20	4	2,5	14
R40-5T6-RSI				6	740	22650	79190	51	54	61	25	4	2,5	18
R40-10T3-RSI		10	6,35	3	400	29590	70690	60	65	68	25	6	3,5	21,5
R40-10T4-RSI				4	510	37890	94260	60	65	79	32	6	3,5	23,5
R50-5T4-RSI	50	5	3,175	4	620	17570	67450	62	65	48	20	4	2,5	14
R50-5T6-RSI				6	910	24900	101170	62	65	61	25	4	2,5	18
R50-10T3-RSI		10	6,35	3	500	33970	92560	69	74	68	32	6	3,5	18
R50-10T4-RSI				4	630	43500	123410	69	74	79	32	6	3,5	23,5
R50-10T6-RSI				6	940	61650	185110	69	74	102	40	6	3,5	31
R63-6T4-RSI	63	6	3,969	4	750	26740	105420	78	80	56	25	6	3,5	15,5
R63-6T6-RSI				6	1130	37040	158130	78	80	70	32	6	3,5	19
R80-10T4-RSI	80	10	6,35	4	960	55590	211180	99	105	79	32	8	4	23,5
R80-10T6-RSI				6	1400	78790	316770	99	105	102	40	8	4	31
R80-20T3-RSI		20	9,525	3	950	96630	316220	108	115	126	50	10	5	38
R80-20T4-RSI				4	1250	123750	421620	108	115	149	63	10	5	43
R100-20T4-RSI	100	20	9,525	4	1550	135690	531610	125	135	149	63	10	5	43

- All dimensions stated without a unit are in mm
- The rigidity values stated are determined by calculation without preload for loading of 30 % of the dynamic load rating
- Deviating nut dimensions on request
- Other diameters and leads on request

Order example:

R	32	10	T4	RSI	1500	1615	0,012
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## Cylindrical double nut RDI with single recirculation

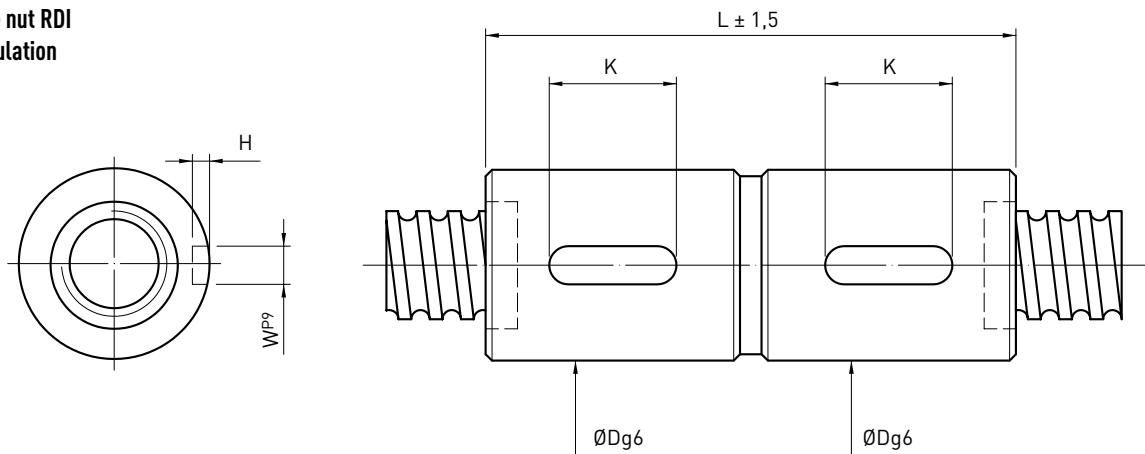


Table 5.8 Nut dimensions

Model	Size		Ball diameter	Circuits	Rigidity K [N/μm]	Dyn. load rating C <sub>dyn</sub> [N]	Static load rating C <sub>0</sub> [N]	Nut			Feather key groove		
	Nominal Ø	Lead						D	L	K	W	H	
R16-5T3-RDI	16	5	3.175	3	200	7310	13310	28	30	72	20	3	1.8
R16-5T4-RDI				4	230	9360	17750	28	30	85	20	3	1.8
R20-5T3-RDI	20	5	3.175	3	390	8520	17670	32	34	75	20	3	1.8
R20-5T4-RDI				4	540	10910	23560	32	34	85	20	3	1.8
R25-5T3-RDI	25	5	3.175	3	550	9770	23140	37	40	75	20	4	2.5
R25-5T4-RDI				4	730	12520	30850	37	40	85	20	4	2.5
R32-5T3-RDI	32	5	3.175	3	640	11170	30810	44	48	75	20	4	2.5
R32-5T4-RDI				4	820	14310	41080	44	48	85	20	4	2.5
R32-5T6-RDI		10	6.35	6	1210	20270	61620	44	48	105	25	4	2.5
R32-10T3-RDI				3	680	25390	53270	51	56	135	25	6	3.5
R32-10T4-RDI	40	5	3.175	4	820	32520	71020	51	56	155	32	6	3.5
R40-5T4-RDI				6	990	15990	52800	51	54	85	20	4	2.5
R40-5T6-RDI		10	6.35	6	1460	22650	79190	51	54	105	25	4	2.5
R40-10T3-RDI				3	760	29590	70690	60	65	135	25	6	3.5
R40-10T4-RDI	50	5	3.175	4	1010	37890	94260	60	65	155	32	6	3.5
R50-5T4-RDI				6	1210	17570	67450	62	65	85	20	4	2.5
R50-5T6-RDI		10	6.35	6	1770	24900	101170	62	65	105	25	4	2.5
R50-10T3-RDI				3	950	33970	92560	69	74	135	32	6	3.5
R50-10T4-RDI	63	5	3.175	4	1240	43500	123410	69	74	155	32	6	3.5
R50-10T6-RDI				6	1840	61650	185110	69	74	197	40	6	3.5
R63-10T4-RDI		10	6.35	4	1580	48600	158580	82	88	160	32	8	4.0
R63-10T6-RDI				6	2280	68870	237860	82	88	202	40	8	4.0
R63-20T4-RDI	80	20	9.525	4	1890	106570	312510	90	95	260	50	8	4.0
R80-10T4-RDI		10	6.35	4	1900	55590	211180	99	105	160	32	8	4.0
R80-10T6-RDI				6	2770	78790	316770	99	105	202	40	8	4.0
R80-20T3-RDI		20	9.525	3	1890	96630	316220	108	115	245	50	10	5.0
R80-20T4-RDI	100			4	2480	123750	421620	108	115	289	63	10	5.0
R100-20T4-RDI	100	20	9.525	4	3000	135690	531610	125	135	289	63	10	5.0

- All dimensions stated without a unit are in mm
- The rigidity values stated are determined by calculation for a preload of 10 % of the dynamic load rating
- Deviating nut dimensions on request
- Other diameters and leads on request

Order example:

R	32	10	T4	RDI	1500	1615	0,012
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# Ballscrews

## Driven nut unit

### 6. Ballscrews for special requirements

#### 6.1 Driven nut unit AME

##### 6.1.1 Sample application

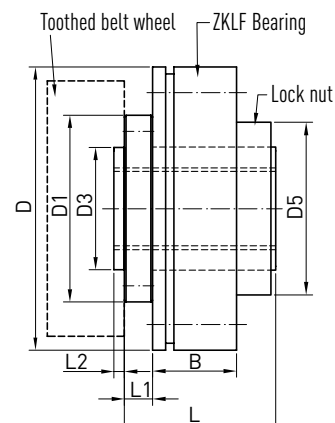
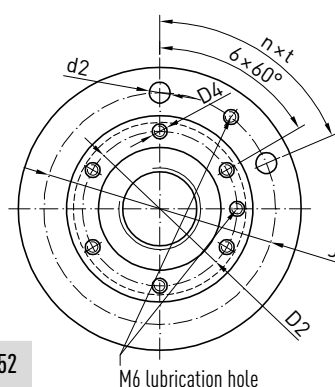
The tool carriage of a machining centre can be moved up to 3000 mm. The maximum rapid motion speed is 25 m/min. The rotary speed of the long feed shaft required for this cannot be reached due to its considerably lower critical bending speed. The ballscrew nut is therefore driven rather than the ballscrew shaft. High axial and radial loading capacity and a good resistance to tilting are required of the bearing.

#### Design solution

The threaded nut is mounted in an axial angular ball bearing ZKLF...2Z. The less stringent PE version is preferred. The bearing has defined preload using a precision groove nut from the HIR series. The bearing achieves a good resistance to tilting thanks to the O arrangement of the two rows of balls. Any axial and radial forces which arise are absorbed with ease. The thick-walled, dimensionally-stable outer bearing race is screwed directly onto the bearing block.



There is no need for an extra bearing bush or bearing cover. Circulating oil lubrication supplies the bearing with lubricant. The ballscrew nut is lubricated via a radial bore in the shaft. The less stringent axial angular ball bearing can only be lubricated axially. We are happy to develop the right unit for any application, taking due account of different installation circumstances. A wide range of realised applications provides the ideal basis for finding a solution to your problem.



Order example: **R** **40** **20** **T2** **AME** **3800** **3900** **0,052**

Table 6.1 Nut dimensions

Article no.	Shaft dimensions			Nut dimensions								Bearing dimensions						Dyn. load rating $C_{dyn}$ [N]	Static load rating $C_0$ [N]	n max. [rpm]
	ds h6	P	dk	D1	D2	D3 h8	D4	D5	L	L1	L2	D-0.01	J	n × t	d2	B				
R16-05T3-AME	16	5	13.5	50	40	30	M6	47	50	10	3	80	63	6 × (60°)	6.5	28	9600	12700	4000	
R20-05T4-AME	20	5	17.5	63	52	40	M6	60	60	12	5	100	80	4 × (90°)	8.5	34	13900	21800	3300	
R25-05T4-AME	25	5	22.5	76	60	50	M6	72	63	15	5	115	94	6 × (60°)	8.5	34	15600	27900	3000	
R25-10T3-AME	25	10	21	76	60	50	M6	72	74	15	5	115	94	6 × (60°)	8.5	34	24100	36200	3000	
R32-05T5-AME	32	5	29.5	76	62	50	M8	72	70	15	5	115	94	6 × (60°)	8.5	34	20700	43900	3000	
R32-10T4-AME	32	10	27.8	76	62	50	M8	72	105	15	5	115	94	6 × (60°)	8.5	34	40900	63200	3000	
R32-20T2-AME	32	20	27.8	76	62	50	M8	72	100	15	5	115	94	6 × (60°)	8.5	34	20300	26800	3000	
R40-05T5-AME	40	5	37.5	90	70	60	M8	82	76	15	5	145	120	8 × (45°)	8.5	45	22500	54600	2400	
R40-10T3-AME	40	10	35.8	90	70	60	M8	82	85	15	5	145	120	8 × (45°)	8.5	45	37100	61900	2400	
R40-20T2-AME	40	20	35.8	90	70	60	M8	82	105	15	5	145	120	8 × (45°)	8.5	45	23800	36400	2400	
R50-05T5-AME	50	5	47.5	100	84	70	M10	94	78	15	5	155	130	8 × (45°)	8.5	45	24900	69800	2200	
R50-10T4-AME	50	10	45.8	100	84	70	M10	94	95	15	5	155	130	8 × (45°)	8.5	45	52800	106800	2200	
R50-20T3-AME	50	20	45.8	100	84	70	M10	94	120	15	5	155	130	8 × (45°)	8.5	45	40000	76200	2200	
R63-10T6-AME	63	10	58.8	130	110	90	M10	122	120	20	7	190	165	8 × (45°)	10.5	55	84700	210800	1800	



## 6.2 Ballscrews for heavy-duty operation

### 6.2.1 Areas of application

Ballscrews for heavy-duty operation are used in applications such as in injection moulding machines, die casting machines, presses, driving mechanisms and robots.

### 6.2.2 Performance features

#### 1. Can withstand high loads

- A. Load capacities 2–3 times greater than standard versions
- B. High load rating for axial loads, good acceleration
- C. Short travel distance thanks to special design for lubrication

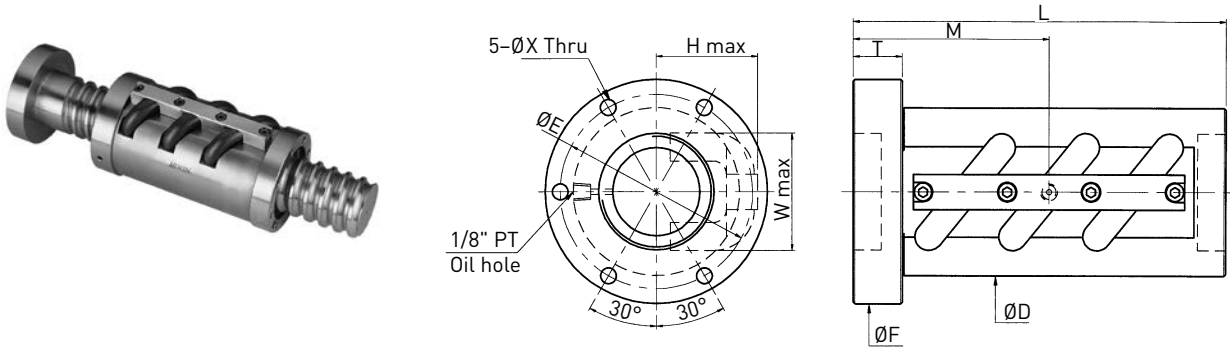
#### 2. Accuracy

T5 and T7

#### 3. High rapid motion speeds and long service life

Reinforced ball recirculation systems for use at high speeds and with long service lives

#### 4. Maximum length: 2 m



Order example: **R** **80** **25** **B3** **FSV** **1180** **1530** **0,023**

Table 6.2 Nut dimensions

Model	Nominal diameter	Lead	Circuits	Dynamic load rating $C_{dyn}$ [kN]	Static load rating $C_0$ [kN]	D	L	F	T	E	X	H	W
R45-10B3-FSV	45	10	2.5 × 3	145	488	70	143	104	18	87	9	47	52
R50-12B3-FSV	50	12	2.5 × 3	175	602	77	171	111	22	94	9	52	59
R50-16B3-FSV	50	16	2.5 × 3	330	971	95	223	129	28	112	9	68	66
R55-16B3-FSV	55		2.5 × 3	343	1054	99	223	133	28	116	9	70	70
R63-16B3-FSV	63		2.5 × 3	368	1217	105	223	139	28	122	9	72.5	76
R80-16B3-FSV	80		2.5 × 3	409	1543	120	227	154	32	137	9	80	92
R80-25B3-FSV		25	2.5 × 3	714	2366	145	338	185	40	165	11	102	100
R100-16B3-FSV	100	16	2.5 × 3	453	1949	145	227	185	32	165	11	91	109
R100-25B3-FSV		25	2.5 × 3	788	2920	159	338	199	40	179	11	108.5	118
R120-25B3-FSV	120	25	2.5 × 3	850	3473	173	338	213	40	193	11	116	135

# Ballscrews

## Accessories

### 7. Shaft ends and accessories

#### 7.1 Shaft ends and bearing configuration

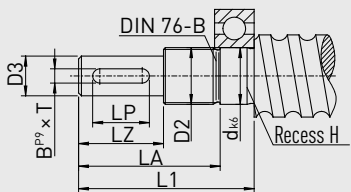
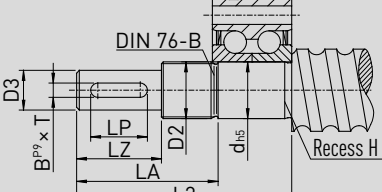
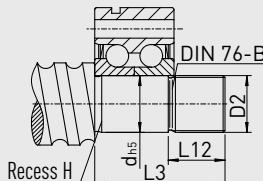
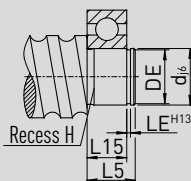
To reduce the amount of design work required, we provide standardised end machining processes and bearing units. We recommend the "B", "E" and "F" bearing series for simple applications and low axial forces. They are suited to all tasks in applications where the ballscrew is not subject to stringent requirements. The SFA and SLA bearing units are suited to more challenging applications. The WBK series is available for heavy-duty applications.

When selecting the suitable bearing type, the permissible axial force of the fixed bearing must also be taken into account.

#### Types of assembly

The type of installation and mounting of the ballscrew shafts are decisive for rigidity, critical speed and buckling load. This must be given careful consideration when selecting the type of assembly.

Table 7.1 Overview of standard shaft ends for SFA, SLA bearing series

	
<b>Type S1</b> Bearing: Deep groove ball bearing 60.. or 62.. For SLA bearing unit	<b>Type S2</b> Bearing: ZKLF.. or ZKLN.. For SFA bearing unit
	
<b>Type S3</b> Bearing: ZKLF.. or ZKLN.. For SFA bearing unit	<b>Type S5</b> Bearing: Deep groove ball bearing 62.. For SLA bearing unit

#### Example:

Designation of shaft end, type S2, with the fit diameter  $d = 20$ : S2-20.

Table 7.2 Abmessungen Standard-Spindelenden für Lagerbaureihen SFA, SLA

Shaft end type	KGT nominal $\emptyset$	d	D2	D3	L1	L2	L3	L5	L12	L15	DE	LE	LA	LP	LZ	B <sup>P9</sup> × T	Recess H
S_-06	12	6	M6 × 0.5	5 j6	31	37	—	8	—	6	5.7 h10	0.8	26	—	16	—	10002475
S_-10	15, 16	10	M10 × 0.75	8 j6	39	50	30	12	12	9	9.6 h10	1.1	32	14	20	2 × 1.2	10002475
S_-12	20	12	M12 × 1	10 j6	43	58	35	13	12	10	11.5 h11	1.1	35	16	23	3 × 1.8	10002475
S_-17	25	17	M17 × 1	14 j6	60	73	43	15	20	12	16.2 h11	1.1	50	20	30	5 × 3	10002475
S_-20	25*, 32	20	M20 × 1	14 j6	62	76	46	17	20	14	19 h12	1.3	50	20	30	5 × 3	DIN509-E0.6 × 0.3
S_-25	32**, 40	25	M25 × 1.5	20 j6	83	96	46	19	20	15	23.9 h12	1.3	71	36	50	6 × 3.5	DIN509-E0.6 × 0.3
S_-30	40	30	M30 × 1.5	25 j6	95	108	48	20	22	16	28.6 h12	1.6	82	45	60	8 × 4	10002476
S_-40	50	40	M40 × 1.5	32 k6	119	135	55	22	24	18	37.5 h12	1.85	104	56	80	10 × 5	DIN509-E0.6 × 0.3
S_-50	63	50	M50 × 1.5	40 k6	142	155	55	25	24	20	47 h12	2.15	124	70	100	12 × 5	10002476
S_-60	80	60	M60 × 2	50 k6	155	177	67	28	25	22	57 h12	2.15	135	70	110	14 × 5.5	10002476

Unit: mm

\* depending on actual shaft outer diameter  $d_{s \min} = 24.5$ ; \*\* depending on actual shaft outer diameter  $d_{s \min} = 31.5$

Table 7.3 Overview of standard shaft ends for EK, BK, FK, EF, BF, FF bearing series

<p><b>Type E8</b> Bearing: 70.. For EK, FK bearing units</p>	<p><b>Type E9</b> Bearing: 72.. For BK bearing unit</p>
<p><b>Type E10</b> Bearing: Deep groove ball bearing 60.. or 62.. For EF, BF, FF bearing unit</p>	

**Example:**

Designation of shaft end, type S3, with the fit diameter  $d = 10$ : S3-10.

Table 7.4 Dimensions of standard shaft ends for EK, BK, FK, EF, BF, FF bearing series

Shaft end type	KGT nominal $\emptyset$	d h6	D4 j6	D5	D10 j6	L8	L9	L10	L16	L17	DE <sub>0.2</sub>	LB	LC	LP	B <sup>9</sup> × T	C	Recess H
E_-08	12	8	6	M8 × 1	6	41	—	9	6	0.8	5.8	9	19	—	—	5.5	DIN509-E0.6 × 0.2
E_-10	15, 16	10	8	M10 × 1	8	56	—	10	7	0.9	7.7	20	31	14	2 × 1.2	5.5	DIN509-E0.6 × 0.2
E_10-12 E_-08-12	16*	12	10	M12 × 1	10	59	—	11	8	1.15	9.6	23	34	16	3 × 1.8	5.5	10002475 DIN509-E0.6 × 0.2
E_-15	20	15	12	M15 × 1	15	70	—	13	9	1.15	14.3	23	36	16	4 × 2.5	10	DIN509-E0.6 × 0.2
E_-20	25	20	17	M20 × 1	20	92	—	19	14	1.35	19.0	30	47	20	5 × 3.0	11	DIN509-E0.6 × 0.3
E_-25	32	25	20	M25 × 1.5	25	126	115	20	15	1.35	23.9	50	70 (68) <sup>2)</sup>	36	6 × 3.5	15 (9) <sup>2)</sup>	DIN509-E0.8 × 0.3
E_-30	40	30	25	M30 × 1.5	30	132	132	21	16	1.75	28.6	60	85	45	8 × 4.0	9	10002476
E_-40	50	40	35 <sup>1)</sup>	M40 × 1.5	40	—	173	23	18	1.95	38.0	80	115	56	10 × 5	15	DIN509-E0.8 × 0.3

Unit: mm

\* depending on actual shaft outer diameter  $d_{s \min} = 15.5$

<sup>1)</sup> Tolerance k6

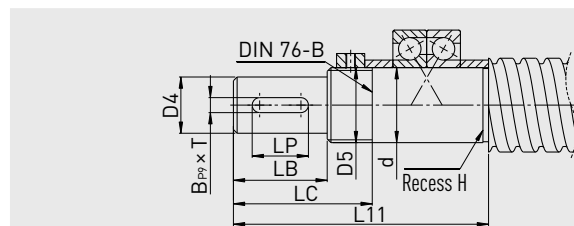
<sup>2)</sup> for BK 25

It goes without saying that we also machine the shaft ends to your drawings and individual requirements.

# Ballscrews

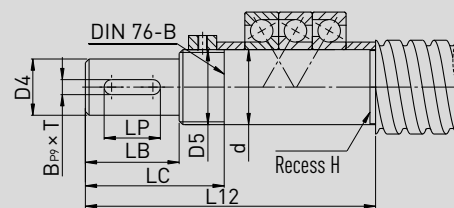
## Accessories

Table 7.5 Overview of standard shaft ends for WBK bearing series



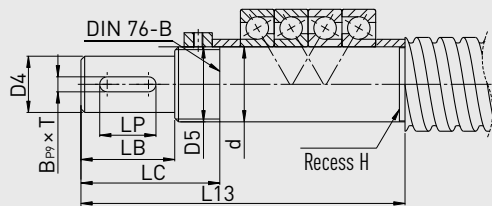
### Type W1

Bearing: BSB.. For WBK\_DF bearing unit



### Type W2

Bearing: BSB.. For WBK\_DFD bearing unit



### Type W3

Bearing: BSB.. For WBK\_DFF bearing unit

### Example:

Designation of shaft end, type W2, with the fit diameter  $d = 20$ : W2-20.

Table 7.6 Dimensions of standard shaft ends for WBK bearing series

Shaft end type	KGT nominal $\emptyset$	d h6	D4 j6	D5	L11	L12	L13	LB	LC	LP	W x D	Recess H
W_-15	20	15	12	M15 x 1	104	—	—	23	46	16	4 x 2.5	DIN509-E0.6 x 0.2
W_-17	25	17	14	M17 x 1	111	—	—	30	53	20	5 x 3.0	10002475
W_-20*	25	20	17	M20 x 1	111	—	—	30	53	20	5 x 3.0	DIN509-E0.6 x 0.3
W_-25**	32	25	20	M25 x 1.5	139	154	—	50	76	36	6 x 3.5	DIN509-E0.8 x 0.3
W_-30	40	30	25	M30 x 1.5	149	164	—	60	86	45	8 x 4.0	10002476
W_-35	45	35	30	M35 x 1.5	152	167	182	60	90	45	8 x 4.0	DIN509-E0.8 x 0.3
W_-40	50	40	35 <sup>1)</sup>	M40 x 1.5	172	187	202	80	110	56	10 x 5.0	DIN509-E0.8 x 0.3

Unit: mm

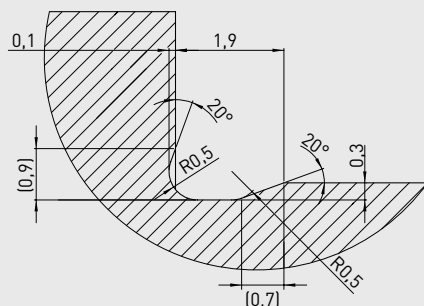
<sup>1)</sup> Tolerance k6

It goes without saying that we also machine the shaft ends to your drawings and individual requirements.

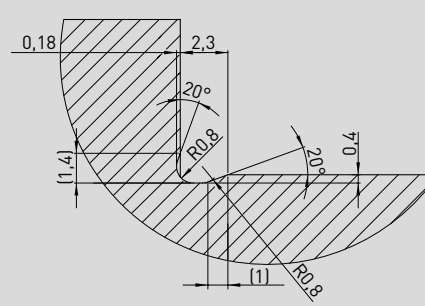
\* depending on actual shaft outer diameter  $d_{s \min} = 24.5$

\*\* depending on actual shaft outer diameter  $d_{s \min} = 31.5$

Table 7.7 HIWIN recesses



### HIWIN recess 10002475



### HIWIN recess 10002476

Table 7.8 Overview of bearing type and associated end machining for SLA, SFA bearing units

KGT nominal Ø	Fixed bearing		Supported bearing	
	Pillow block	End machining	Pillow block	End machining
12	SFA06	S2-06 / S3-06	SLA06	S1-06 / S5-06
15, 16	SFA10	S2-10 / S3-10	SLA10	S1-10 / S5-10
20	SFA12	S2-12 / S3-12	SLA12	S1-12 / S5-12
25	SFA17	S2-17 / S3-17	SLA17	S1-17 / S5-17
32	SFA20	S2-20 / S3-20	SLA20	S1-20 / S5-20
40	SFA30	S2-30 / S3-30	SLA30	S1-30 / S5-30
50	SFA40	S2-40 / S3-40	SLA40	S1-40 / S5-40

Table 7.9 Overview of bearing type and associated end machining for EK, BK, FK, EF, BF, FF bearing series

KGT nominal Ø	Fixed bearing				Supported bearing			
	Pillow block	End machining	Flange bearing	End machining	Pillow block	End machining	Flange bearing	End machining
12	EK08	E8-08	FK08	E8-08	EF08	E10-08	—	—
15, 16	EK10	E8-10	FK10	E8-10	EF10	E10-10	FF10	E10-10
16*	EK12	E8-12	FK12	E8-12	EF12	E10-12	FF12	E10-12
20	EK15	E8-15	FK15	E8-15	EF15	E10-15	FF15	E10-15
25	EK20	E8-20	FK20	E8-20	EF20	E10-20	FF20	E10-20
32	BK25	E9-25	FK25	E8-25	BF25	E10-25	FF25	E10-25
40	BK30	E9-30	FK30	E8-30	BF30	E10-30	FF30	E10-30
50	BK40	E9-40	—	—	BF40	E10-40	—	—

\* depending on actual shaft outer diameter  $d_{s \min} = 15.5$

Table 7.10 Overview of bearing type and associated end machining for WBK bearing unit

KGT nominal Ø	Flange bearing	End machining
20	WBK 15 DF	W1-15
25	WBK 17 DF	W1-17
25	WBK 20 DF	W1-20
32	WBK 25 DF	W1-25
32	WBK 25 DFD	W2-25
40	WBK 30 DF	W1-30
40	WBK 30 DFD	W2-30
45	WBK 35 DF	W1-35
45	WBK 35 DFD	W2-35
45	WBK 35 DFF	W3-35
50	WBK 40 DF	W1-40
50	WBK 40 DFD	W2-40
50	WBK 40 DFF	W3-40

# Ballscrews

## Accessories

### 7.2 WBK bearing series

Thanks to their robust steel bearing housing, the flange bearing units of the WBK series are especially suited to use in heavy-duty ballscrews. Depending on the axial loads present, the WBK bearing units are available with the DF, DFD and DFF bearing arrangements.

The end machining processes suited to the WBK fixed bearing are types W1, W2 and W3 (chapter 7.1).

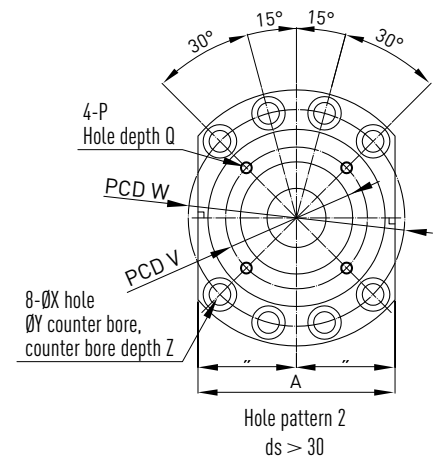
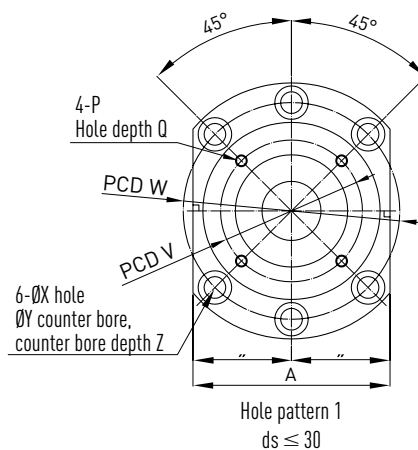
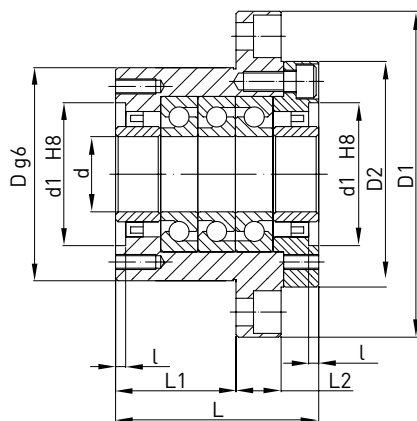
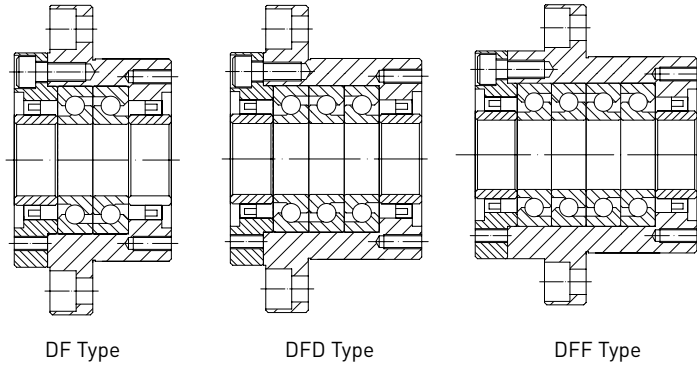


Table 7.11 Bearing unit dimensions

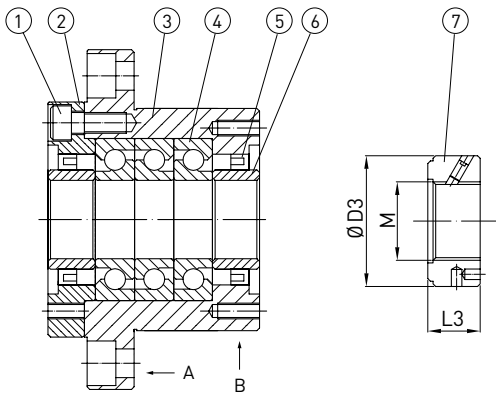
Article no.	Nominal shaft Ø	d	D	D1	D2	L	L1	L2	A	W	X	Y	Z	d1	l	V	P	Q
WBK 15 DF	20	15	70	106	72	60	32	15	80	88	9	14	8,5	45	3	58	M5	10
WBK 17 DF	25	17	70	106	72	60	32	15	80	88	9	14	8,5	45	3	58	M5	10
WBK 20 DF	25	20	70	106	72	60	32	15	80	88	9	14	8,5	45	3	58	M5	10
WBK 25 DF	32	25	85	130	90	66	33	18	100	110	11	17,5	11	57	4	70	M6	12
WBK 25 DFD	32	25	85	130	90	81	48	18	100	110	11	17,5	11	57	4	70	M6	12
WBK 30 DF	40	30	85	130	90	66	33	18	100	110	11	17,5	11	57	4	70	M6	12
WBK 30 DFD	40	30	85	130	90	81	48	18	100	110	11	17,5	11	57	4	70	M6	12
WBK 35 DF	45	35	95	142	102	66	33	18	106	121	11	17,5	11	69	4	80	M6	12
WBK 35 DFD	45	35	95	142	102	81	48	18	106	121	11	17,5	11	69	4	80	M6	12
WBK 35 DFF	45	35	95	142	102	96	48	18	106	121	11	17,5	11	69	4	80	M6	12
WBK 40 DF	50	40	95	142	102	66	33	18	106	121	11	17,5	11	69	4	80	M6	12
WBK 40 DFD	50	40	95	142	102	81	48	18	106	121	11	17,5	11	69	4	80	M6	12
WBK 40 DFF	50	40	95	142	102	96	48	18	106	121	11	17,5	11	69	4	80	M6	12

Unit: mm

### Bearing arrangements



### Bearing structure



(1) Retaining bolt, (2) Bearing cover, (3) Bearing housing, (4) Bearing, (5) Seal, (6) Spacer, (7) Lock nut

Note:

1. Use reference planes A and B for alignment during assembly.
2. To ensure high accuracy, parts 1 – 6 must not be disassembled.

Table 7.12 **Technical data of bearing**

Article no.	Dynamic load rating [kN]	Permissible axial load [kN]	Preload [kN]	Axial rigidity [N/μm]	Starting torque [Nm]	Lock nut			Weight [kg]
						M	D3	L3	
<b>WBK 15 DF</b>	21.9	26.6	2.15	750	0.19	M15 × 1	30	14	1.9
<b>WBK 17 DF</b>	21.9	26.6	2.15	750	0.19	M17 × 1	32	16	1.9
<b>WBK 20 DF</b>	21.9	26.6	2.15	750	0.19	M20 × 1	38	16	1.9
<b>WBK 25 DF</b>	28.5	40.5	3.15	1000	0.29	M25 × 1.5	38	18	3.1
<b>WBK 25 DFD</b>	46.5	81.5	4.3	1470	0.39	M25 × 1.5	38	18	3.4
<b>WBK 30 DF</b>	29.2	43.0	3.35	1030	0.30	M30 × 1.5	45	18	3.0
<b>WBK 30 DFD</b>	47.5	86.0	4.5	1520	0.40	M30 × 1.5	45	18	3.3
<b>WBK 35 DF</b>	31.0	50.0	3.8	1180	0.34	M35 × 1.5	52	18	3.4
<b>WBK 35 DFD</b>	50.5	100.0	5.2	1710	0.45	M35 × 1.5	52	18	4.3
<b>WBK 35 DFF</b>	50.5	100.0	7.65	2350	0.59	M35 × 1.5	52	18	5.0
<b>WBK 40 DF</b>	31.5	52.0	3.9	1230	0.36	M40 × 1.5	58	20	3.6
<b>WBK 40 DFD</b>	51.5	104.0	5.3	1810	0.47	M40 × 1.5	58	20	4.2
<b>WBK 40 DFF</b>	51.5	104.0	7.85	2400	0.61	M40 × 1.5	58	20	4.7

# Ballscrews

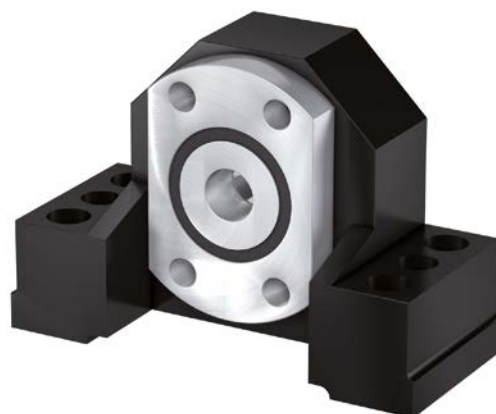
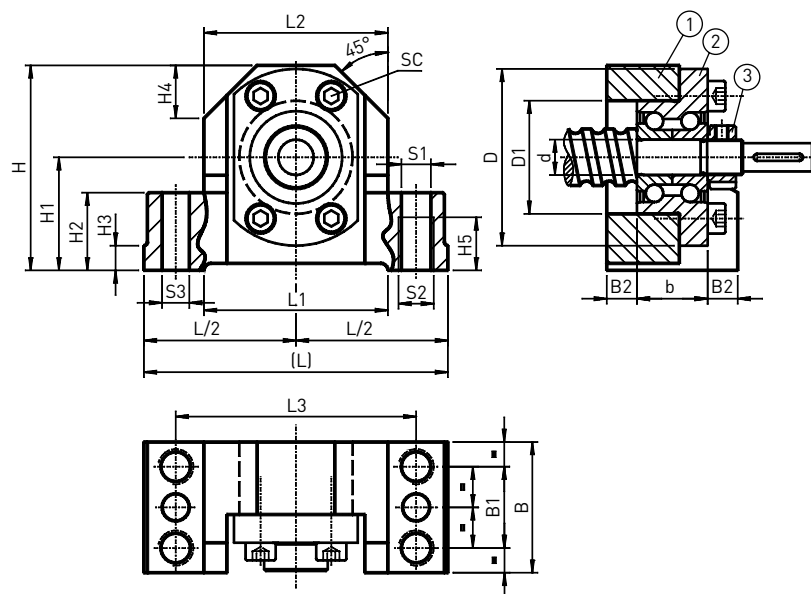
## Accessories

### 7.3 SFA/SLA bearing series

#### 7.3.1 Fixed bearing SFA

The axis height of the fixed bearing is matched to supported bearing SLA (chapter 7.3.2) and nut housing GFD (chapter 7.4). The pillow block can be screwed on from above (S1) and below (S2).

The reference edge makes it easier to align the unit. The fixed bearing can be pinned with two tapered pins or cylindrical pins. The end machining suited to the fixed bearing is the S2-xx/S3-xx type (chapter 7.1).



(1) Steel pillow block housing, (2) Bearing, (3) Lock nut



Table 7.13 Bearing unit dimensions

Article no.	Shaft nominal $\varnothing$	L	L/2 js9	L1	L2	L3	H	H1 js9	H2	H3	H4	H5	d	D	D1	b
SFA06	12	62	31	34	38	50	41	22	13	5	11	9	6	30	19	12
SFA10	16	86	43	52	52	68	58	32	22	7	15	15	10	50	32	20

Unit: mm

Table 7.14 Bearing unit dimensions

Article no.	Shaft nominal $\varnothing$	B	B1	B2	S1 H12	S2	S3	SC ISO 4762-10.9
SFA06	12	32	16	10.0	5.3	M6	3.7	4 × M3 × 12
SFA10	16	37	23	8.5	8.4	M10	7.7	4 × M5 × 20

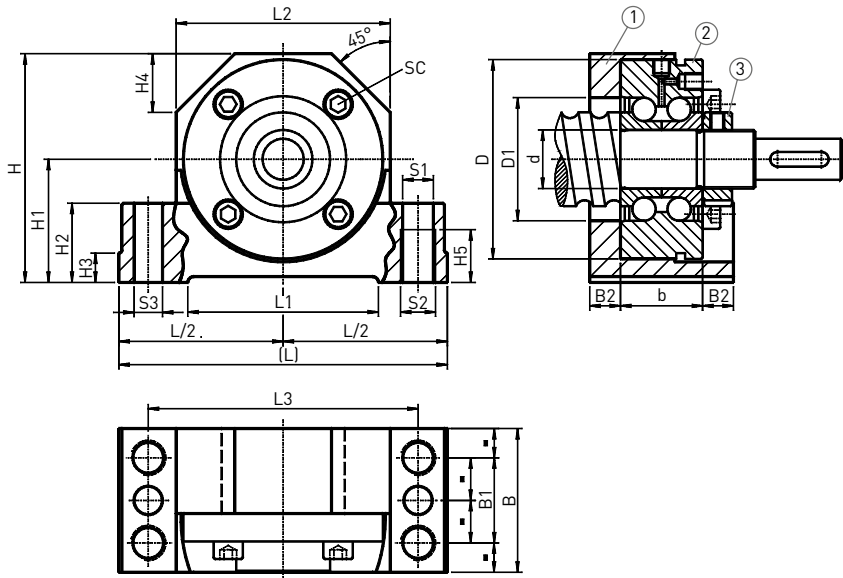
Unit: mm

Table 7.15 Technical data of bearing

Article no.	Bearing type	$C_0$ axial [N]	$C_{dyn}$ axial [N]	Max. speed [n/min]	Lock nut			
					Type	Nut tightening torque [Nm]	Screw size	Screw tightening torque [Nm]
SFA06	ZKLFA0630.2Z	6100	4900	14000	HIR 06	2	M4	1
SFA10	ZKLFA1050.2RS	8500	6900	6800	HIR 10	6	M4	1



**SFA-12 – SFA-40**



(1) Steel pillow block housing, (2) Bearing, (3) Lock nut



Table 7.16 Bearing unit dimensions

Article no.	Shaft nominal Ø	L	L/2 js9	L1	L2	L3	H	H1 js9	H2	H3	H4	H5	d	D	D1	b
SFA12	20	94	47	52	60	77	64	34	22	7	17	15	12	55	32	25
SFA17	25	108	54	65	66	88	72	39	27	10	19	18	17	62	36	25
SFA20	32	112	56	65	73	92	78	42	27	10	20	18	20	68	42	28
SFA30	40	126	63	82	84	105	92	50	32	13	23	21	30	80	52	28
SFA40	50	146	73	82	104	125	112	60	32	13	30	21	40	100	66	34

Unit: mm

Table 7.17 Bearing unit dimensions

Article no.	Shaft nominal Ø	B	B1	B2	S1 H12	S2	S3	Lock nut	SC ISO 4762-10.9
SFA12	20	42	25	8.5	8.4	M10	7.7	HIR 12	3 × M6 × 35
SFA17	25	46	29	10.5	10.5	M12	9.7	HIR 17	3 × M6 × 35
SFA20	32	49	29	10.5	10.5	M12	9.7	HIR 20 × 1	4 × M6 × 40
SFA30	40	53	32	12.5	12.6	M14	9.7	HIR 30	6 × M6 × 40
SFA40	50	59	34	12.5	12.6	M14	9.7	HIR 40	4 × M8 × 50

Unit: mm

Table 7.18 Technical data of bearing

Article no.	Bearing type	C <sub>0</sub> axial [N]	C <sub>dyn</sub> axial [N]	Max. speed [n/min]	Lock nut			
					Type	Nut tightening torque [Nm]	Screw size	Screw tightening torque [Nm]
SFA12	ZKLF1255.2RS	24700	17000	3800	HIR 12	8	M4	1
SFA17	ZKLF1762.2RS	31000	18800	3300	HIR 17	15	M5	3
SFA20	ZKLF2068.2RS	47000	26000	3000	HIR 20 × 1	18	M5	3
SFA30	ZKLF3080.2RS	64000	29000	2200	HIR 30	32	M6	5
SFA40	ZKLF40100.2RS	101000	43000	1800	HIR 40	55	M6	5

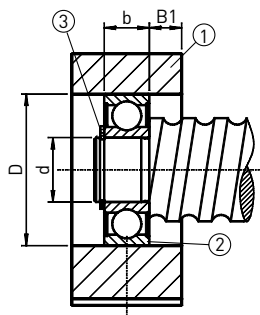
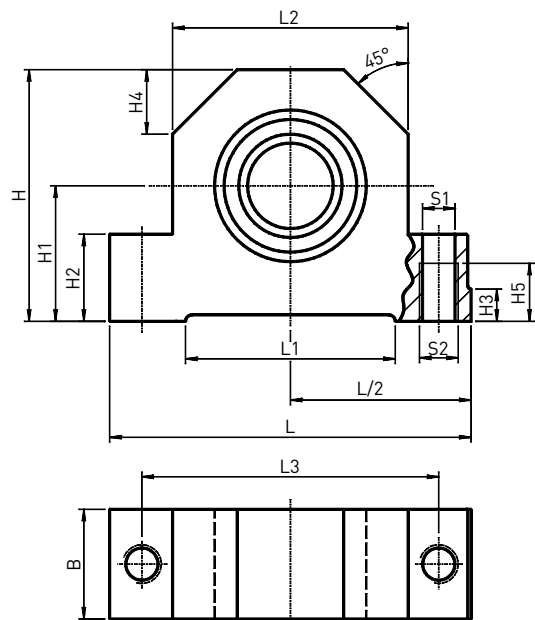
# Ballscrews

## Accessories

### 7.3.2 SLA bearing series

The axis height of the supported bearing is matched to fixed bearing SFA (chapter 7.3.1) and nut housing GFD (chapter 7.4). The pillow block can be screwed on from above (S1) and below (S2).

The reference edge makes it easier to align the unit. The end machining suited to the supported bearing is the S1-x type (chapter 7.1).



(1) Steel pillow block housing, (2) Bearing, (3) Lock nut



Table 7.19 Bearing unit dimensions

Article no.	Shaft nominal Ø	L	L/2 js9	L1	L2	L3	H	H1 js9	H2	H3	H4	H5	b
SLA06	12	62	31	34	38	50	41	22	13	5	11	9	6
SLA10	16	86	86	52	52	68	58	32	22	7	15	15	9
SLA12	20	94	47	52	60	77	64	34	22	7	17	15	10
SLA17	25	108	54	65	66	88	72	39	27	10	19	18	12
SLA20	32	112	56	65	73	92	78	42	27	10	20	18	14
SLA30	40	126	63	82	84	105	92	50	32	13	23	21	16
SLA40	50	146	73	82	104	125	112	60	32	13	30	21	18

Unit: mm

Table 7.20 Bearing unit dimensions

Article no.	Shaft nominal Ø	B	B1	S1 H12	S2	d	D H6	Circlip DIN 471	Deep groove ball bearing DIN 625
SLA06	12	15	4,5	5,3	M6	6	19	6 × 0,7	626.2RS
SLA10	16	24	7,5	8,4	M10	10	30	10 × 1	6200.2RS
SLA12	20	26	8	8,4	M10	12	32	12 × 1	6201.2RS
SLA17	25	28	8	10,5	M12	17	40	17 × 1	6203.2RS
SLA20	32	34	10	10,5	M12	20	47	20 × 1,2	6204.2RS
SLA30	40	38	11	12,6	M14	30	62	30 × 1,5	6206.2RS
SLA40	50	44	13	12,6	M14	40	80	40 × 1,75	6208.2RS

Unit: mm

#### 7.4 Housing for flange nuts (DIN 69051 Part 5)

The nut housing is suitable for assembling flange nuts DEB, DDB and FSCDIN. The axis height of the housing is matched to fixed bearing SFA (chapter 7.3.1) and the supported bearing SLA (chapter 7.3.2).

The housing can be screwed on from above (S1) and below (S2). The housing can be pinned with two tapered pins or cylindrical pins. Screws of strength class 8.8 should be used for the fastening.

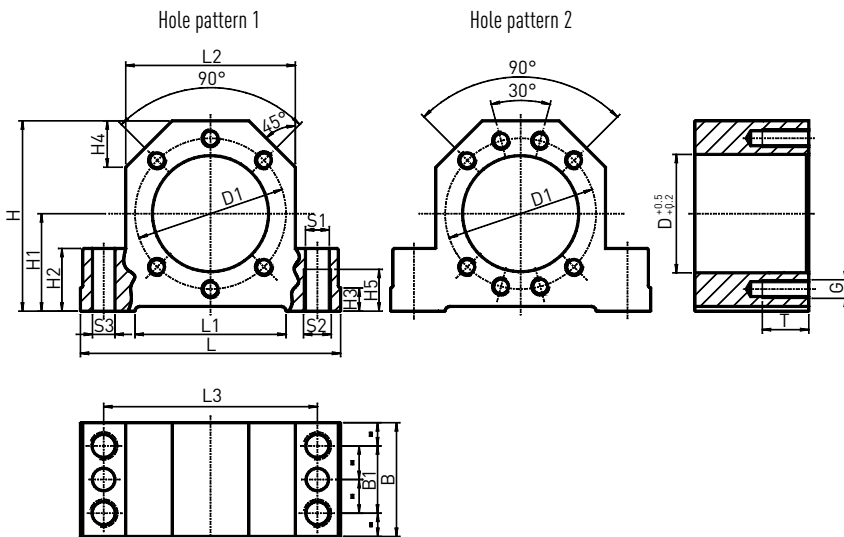


Table 7.21 Bearing unit dimensions

Article no.	Shaft nominal Ø	L	L1	L2	L3	H	H1 js9	H2	H3	H4	H5
GFD16	16	86	52	52	68	58	32	22	7	15	15
GFD20	20	94	52	60	77	64	34	22	7	17	15
GFD-5	25	108	65	66	88	72	39	27	10	19	18
GFD32	32	112	65	72	92	82	42	27	10	19	18
GFD40	40	126	82	84	105	97	50	32	13	23	21
GFD50	50	146	82	104	125	115	60	32	13	30	21

Unit: mm

Table 7.22 Housing dimensions

Article no.	Shaft nominal Ø	D	D1	B	B1	S1 H12	S2	S3	Hole pattern	G	T
GFD16	16	28	38	37	23	8,4	M10	7,7	1	M5	12
GFD20	20	36	47	42	25	8,4	M10	7,7	1	M6	15
GFD25	25	40	51	46	29	10,5	M12	9,7	1	M6	15
GFD32	32	50	65	49	29	10,5	M12	9,7	1	M8	20
GFD40	40	63	78	53	32	12,6	M14	9,7	2	M8	20
GFD50	50	75	93	59	34	12,6	M14	9,7	2	M10	25

Unit: mm

# Ballscrews

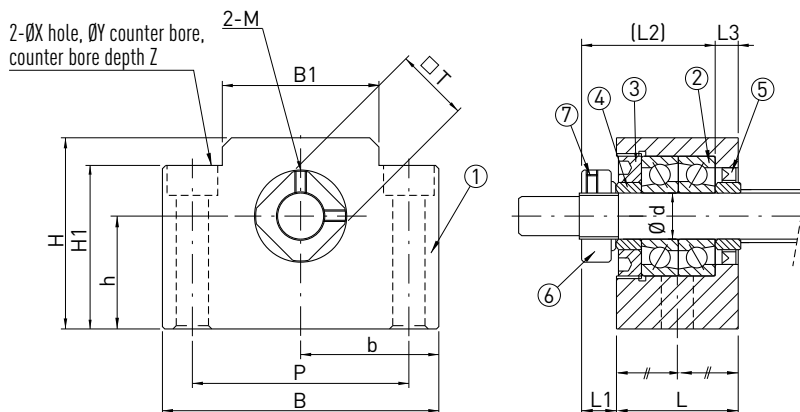
## Accessories

### 7.5 EK/EF bearing series

#### 7.5.1 Fixed bearing EK

The axis height of the fixed bearing is matched to supported bearing EF (chapter 7.5.2).

The end machining suited to fixed bearing EK is the E8-xx type (chapter 7.1).

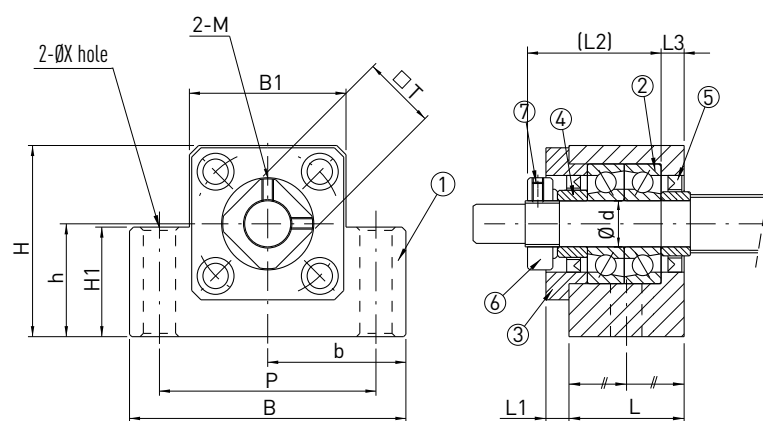


(1) Housing, (2) Bearing, (3) Retaining cover, (4) Support ring, (5) Seal, (6) Clamping nut, (7) Allen set screw

Table 7.23 Bearing unit dimensions

Article no.	Nominal shaft Ø	d	L	L1	L2	L3	B	H	b ± 0.02	h ± 0.02	B1	H1	P	X	Y	Z	M	T
EK08	12	8	23	7	26	4	52	32	26	17	25	26	38	6,6	11	12	M3	14

Unit: mm



(1) Housing, (2) Bearing, (3) Retaining cover, (4) Support ring, (5) Seal, (6) Clamping nut, (7) Allen set screw

Table 7.24 Bearing unit dimensions

Article no.	Nominal shaft Ø	d	L	L1	L2	L3	B	H	b ± 0.02	h ± 0.02	B1	H1	P	X	Y	Z	M	T
EK10	16	10	24	6	29.5	6	70	43	35	25	36	24	52	9	—	—	M3	16
EK12	16*	12	24	6	29.5	6	70	43	35	25	36	24	52	9	—	—	M4	19
EK15	20	15	25	6	36	5	80	49	40	30	41	25	60	11	—	—	M4	22
EK20	25	20	42	10	50	10	95	58	47,5	30	56	25	75	11	—	—	M4	30

Unit: mm

\* depending on actual shaft outer diameter  $d_{s \min} = 15.5$



Table 7.25 Technical data of bearing

Article no.	Bearing type	C <sub>0</sub> axial [N]	C <sub>dyn</sub> axial [N]	Max. permissible axial load [N]	Max. speed [n/min]	Lock nut			
						Type	Nut tightening torque [Nm]	Screw size	Screw tightening torque [Nm]
EK08	708	4800	2800	1100	40000	RN8	2.5	M3	0.6
EK10	7000A P0	8800	5200	2000	24000	RN10	2.9	M3	0.6
EK12	7001A P0	9400	6000	2200	22000	RN12	6.4	M4	1.5
EK15	7002A P0	10000	6900	2400	19000	RN15	7.9	M4	1.5
EK20	7204B P0	21600	15200	6800	9500	RN20	16.7	M4	1.5

### 7.5.2 Supported bearing EF

The axis height of the supported bearing is matched to fixed bearing EK (chapter 7.5.1).  
The end machining suited to supported bearing EF is the E10-xx type (chapter 7.1).

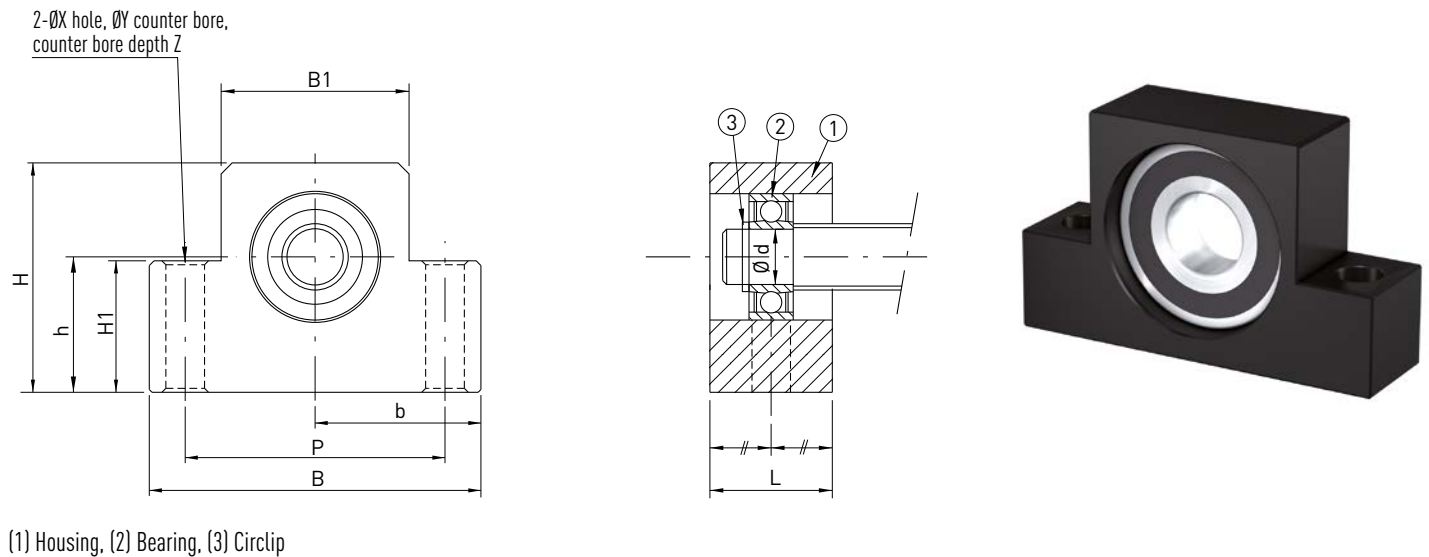


Table 7.26 Bearing unit dimensions

Article number	Nominal shaft Ø	d	L	B	H	b ± 0.02	h ± 0.02	B1	H1	P	X	Y	Z	Bearing	Circlip
EF08	12	6	14	52	32	26	17	25	26	38	6,6	11	12	606ZZ	S 06
EF10	16	8	20	70	43	35	25	36	24	52	9	—	—	608ZZ	S 08
EF12	16*	10	20	70	43	35	25	36	24	52	9	—	—	6000ZZ	S 10
EF15	20	15	20	80	49	40	30	41	25	60	9	—	—	6002ZZ	S 15
EF20	25	20	26	95	58	47.5	30	56	25	75	11	—	—	6204ZZ	S 20

Unit: mm

\* depending on actual shaft outer diameter  $d_{s \min} = 15.5$



# Ballscrews

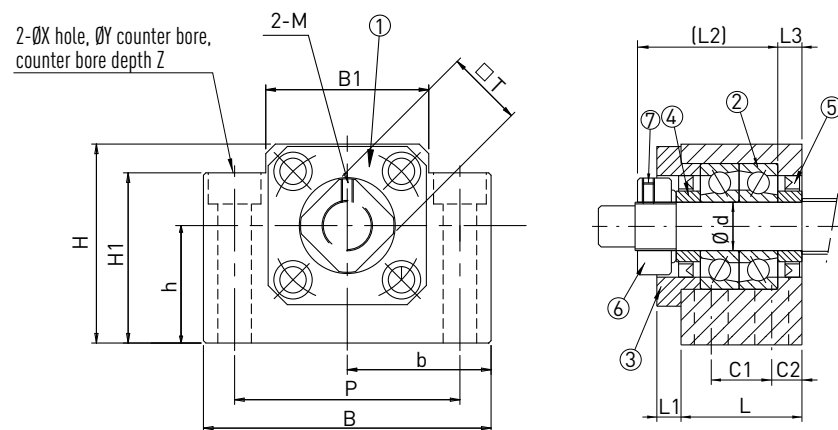
## Accessories

### 7.6 BK/BF bearing series

#### 7.6.1 Fixed bearing BK

The axis height of the fixed bearing is matched to supported bearing BF (chapter 7.6.2).

The end machining suited to fixed bearing BK is the E9-xx type (chapter 7.1).



1) Housing, (2) Bearing, (3) Retaining cover, (4) Support ring, (5) Seal, (6) Clamping nut, (7) Allen set screw



Table 7.27 Bearing unit dimensions

Article no.	Nominal shaft $\varnothing$	d	L	L1	L2	L3	B	H	b $\pm 0.02$	h $\pm 0.02$
BK25	32	25	42	12	54	9	106	80	53	48
BK30	40	30	45	14	61	9	128	89	64	51
BK40	50	40	61	18	76	15	160	110	80	60

Unit: mm

Table 7.28 Bearing unit dimensions

Article no.	Nominal shaft $\varnothing$	B1	H1	P	C1	C2	X	Y	Z	M	T
BK25	32	64	70	85	22	10	11	17	11	M5	35
BK30	40	76	78	102	23	11	14	20	13	M6	40
BK40	50	100	90	130	33	14	18	26	17.5	M8	50

Unit: mm

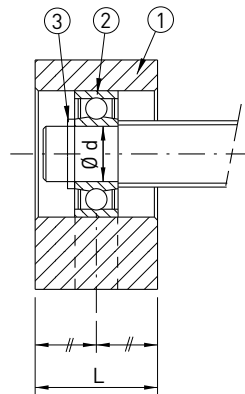
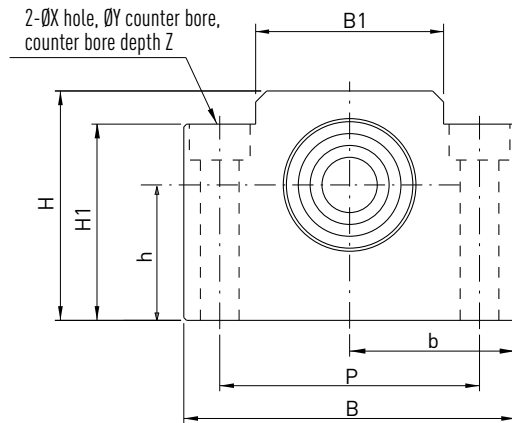
Table 7.29 Technical data of bearing

Article no.	Bearing type	$C_0$ axial [N]	$C_{dyn}$ axial [N]	Max. permissible axial load [N]	Max. speed [n/min]	Lock nut			
						Type	Nut tightening torque [Nm]	Screw size	Screw tightening torque [Nm]
BK25	7205A P0	26300	20500	7000	12000	RN25	21	M6	5
BK30	7206B P0	33500	27000	10600	7100	RN30	31	M6	5
BK40	7208B P0	52000	46100	18000	5300	RN40	71	M6	5

Note: BK25, BK30, BK40 with optional lubrication connection

### 7.6.2 Supported bearing BF

The axis height of the supported bearing is matched to fixed bearing BK (chapter 7.6.1).  
The end machining suited to supported bearing BF is the E10-xx type (chapter 7.1).



(1) Housing, (2) Bearing, (3) Circlip



Table 7.30 Bearing unit dimensions

Article no.	Nominal shaft Ø	d	L	B	H	b ± 0.02	h ± 0.02	B1	H1	P	X	Y	Z	Bearing	Circlip
BF25	32	25	30	106	80	53	48	64	70	85	11	17	11	6205ZZ	S 25
BF30	40	30	32	128	89	64	51	76	78	102	14	20	12	6206ZZ	S 30
BF40	50	40	37	160	110	80	60	100	90	130	18	26	17.5	6208ZZ	S 40

Unit: mm

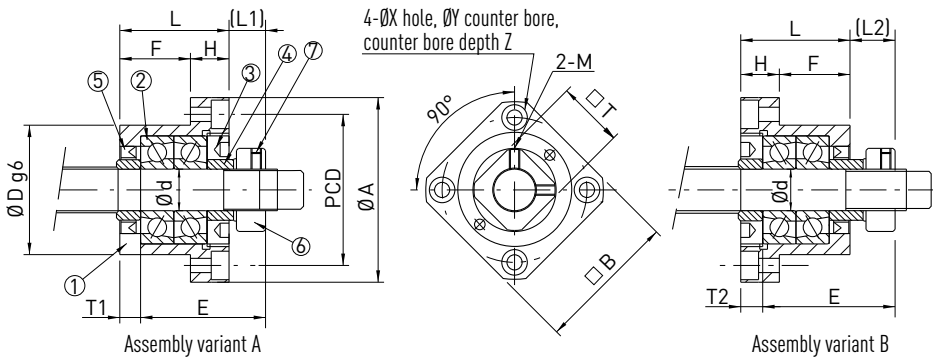
# Ballscrews

## Accessories

### 7.7 FK/FF bearing series

#### 7.7.1 Fixed bearing FK

The associated supporting bearing unit is the FF bearing series (chapter 7.7.2). The end machining suited to fixed bearing FK is the E8-xx type (chapter 7.1).

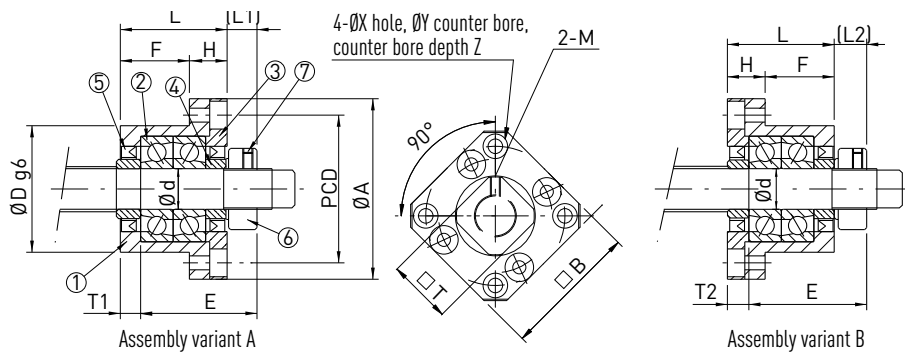


(1) Housing, (2) Bearing, (3) Retaining cover, (4) Support ring, (5) Seal, (6) Clamping nut, (7) Allen set screw

Table 7.31 Bearing unit dimensions

Article no.	Nominal shaft Ø	d	L	H	F	E	Dg6	A	PCD	B	Assembly variant A		Assembly variant B		X	Y	Z	M	T	G	Q
											L1	T1	L2	T2							
FK08	12	8	23	9	14	26	28	43	35	35	7	4	8	5	3.4	6.5	4	M3	14	—	—

Unit: mm



(1) Housing, (2) Bearing, (3) Retaining cover, (4) Support ring, (5) Seal, (6) Clamping nut, (7) Allen set screw







Table 7.32 Bearing unit dimensions

Article no.	Nominal shaft Ø	d	L	H	F	E	Dg6	A	PCD	B	Assembly variant A		Assembly variant B		X	Y	Z	M	T
											L1	T1	L2	T2					
FK10	16	10	27	10	17	29.5	34	52	42	42	7.5	5	8.5	6	4.5	8	4	M3	16
FK12	16*	12	27	10	17	29.5	36	54	44	44	7.5	5	8.5	6	4.5	8	4	M4	19
FK15	20	15	32	15	17	36	40	63	50	52	10	6	12	8	5.5	9.5	6	M4	22
FK20	25	20	52	22	30	50	57	85	70	68	8	10	12	14	6.6	11	10	M4	30
FK25	32	25	57	27	30	59	63	98	80	79	13	10	20	17	9	15.0	13	M5	35
FK30	40	30	62	30	32	61	75	117	95	93	11	12	17	18	11	17.5	15	M6	40

Unit: mm

\* depending on actual shaft outer diameter  $d_{s \min} = 15.5$

Note: FK10, FK12, FK15, FK20, FK25, FK30 optional with lubrication connection

Table 7.33 Technical data of bearing

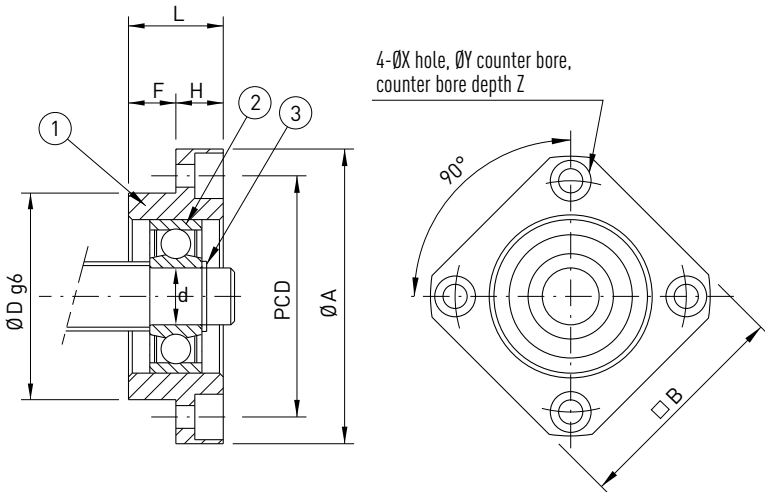
Article number	Bearing type	C <sub>0</sub> axial [N]	C <sub>dyn</sub> axial [N]	Max. permissible axial load [N]	Max. speed [n/min]	Lock nut			
						Type	Nut tightening torque [Nm]	Screw size	Screw tightening torque [Nm]
FK08	708	4800	2800	1000	40000	RN8	2.5	M3	0.6
FK10	7000A P0	8800	5200	1900	24000	RN10	2.9	M3	0.6
FK12	7001A P0	9400	6000	2200	22000	RN12	6.4	M4	1.5
FK15	7002A P0	10000	6900	2400	19000	RN15	7.9	M4	1.5
FK20	7204B P0	21600	15300	6800	9500	RN20	16.7	M4	1.5
FK25	7205B P0	24000	19000	8100	8500	RN25	20.6	M6	4.9
FK30	7206B P0	33500	27000	10600	7100	RN30	31.4	M6	4.9

# Ballscrews

## Accessories

### 7.7.2 Supported bearing FF

The associated fixed bearing unit is the FK bearing series (chapter 7.7.1). The end machining suited to supported bearing FF is the E10-xx type (chapter 7.1).



(1) Housing, (2) Bearing, (3) Circlip



Table 7.34 Bearing unit dimensions

Article no.	Nominal shaft Ø	d	L	H	F	Dg6	A	PCD	B	X	Y	Z	Bearing	Circlip
FF10	16	8	12	7	5	28	43	35	35	3,4	6,5	4	608ZZ	S 08
FF12	16*	10	15	7	8	34	52	42	42	4,5	8	4	6000ZZ	S 10
FF15	20	15	17	9	8	40	63	50	52	5,5	9,5	5,5	6002ZZ	S 15
FF20	25	20	20	11	9	57	85	70	68	6,6	11	6,5	6204ZZ	S 20
FF25	32	25	24	14	10	63	98	80	79	9	14	8,5	6205ZZ	S 25
FF30	40	30	27	18	9	75	117	95	93	11	17	11	6206ZZ	S 30

Unit: mm

\* depending on actual shaft outer diameter ds min = 15.5

## 7.8 Axial angular contact ball bearing

### ZKLN series

Axial angular contact ball bearings of the ZKLN...2RS series are angular contact ball bearings in two rows with a 60° contact angle in an O arrangement. The outer race has a thick wall and is inherently stable. An accuracy of IT6 is therefore sufficient for the housing bore. The surround surface of the outer race has a lubrication groove and three lubrication holes. The two-part inner race is matched to the two ball and cage

### ZKLF series

The differences between bearings of the ZKLF series and those of the ZKLN series are an outer race which can be unscrewed and a different lubrication hole arrangement. Directly screwing the outer race onto the connection construction means that the bearing cover usually needed to lock it in place is not required, neither is the adaptation

### Less stringent PE version

In their normal version, the axial angular contact ball bearings ZKLN and ZKLF are designed for high-precision ballscrews. In many applications, such as handling, wood-working machines and mounting several ballscrews, this precision is not essential. A cheaper version with less stringent tolerances can often achieve the accuracy required for the function.

The ZKLN and ZKLF series with less stringent tolerances (indicated by the additional characters PE) provide the characteristics of the normal version, such as good loading capacity and rigidity with a high speed limit, as well as being easy to assemble and requiring little maintenance.

Benefits of the less stringent version:

- Cheaper
- Unit suited to function
- Less production work involved in connection construction

The less stringent PE version is available in hole diameters of 12 to 50.

### Installation/removal

When installing the axial angular contact ball bearing, ensure that the assembly forces are not channelled via the rolling elements.

The retaining bolts of the ZKLF bearing should be tightened crosswise. The retaining bolts may be loaded up to 70 % of their yield strength.

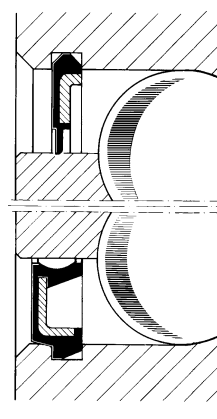
The surround surface of the outer race has an extraction slot all the way round to speed up removal of bearings in the ZKLF series.

Tightening the lock nuts preloads the axial angular ball bearings. The nut tightening torques stated in the dimensions tables should be observed.

Once the lock nuts have been tightened, the two locking threaded pins should be tightened with a hexagon socket. Tighten the locking threaded pins alternately. To counteract settling effects, we would recommend initially tightening the lock nuts to three times the stated tightening torque  $M_A$ . Then relieve the lock nuts. They should then be tightened again to the tightening torques  $M_A$  stated in the dimensions tables.

assemblies and outer race such that the bearing is ideally preloaded when the lock nut is tightened to the specified tightening torque. Axial angular contact ball bearings are self-locking. They have sealing rings on both sides and are supplied ready to install and greased for life. No additional seals are needed in the surrounding construction.

work required in advance. There is an extraction slot all the way round the surround surface of the outer race to simplify disassembly. One radial and one axial M6 threaded hole permit re-lubrication in special applications.



Contact sealing disc  
Additional characters .2RS

Gap seal  
Additional characters .2Z

When disassembling, proceed in reverse and first loosen the two locking threaded pins and then the lock nuts. If assembled and disassembled correctly, lock nuts can be used several times.

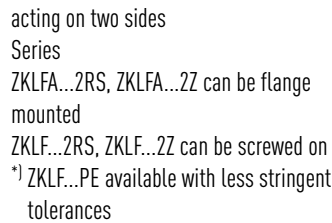
The dimensions of the bearing's inner races are such that a defined preload, sufficient for most applications, is achieved when the lock nut is tightened (tightening torque  $M_A$  according to dimensions table).

Deviating tightening torques  $M_A$  can be selected for special applications. Please contact us in such instances.

If the bearing friction torque  $M_{RL}$  can be checked, compare the values measured with those in the dimensions tables.

# Kugelgewindetriebe

## Zubehör



**Table 7.35 Dimensions and connecting dimensions for angular ball bearing unit ZKLFA**

Shaft diam-eter	Code	Weight [kg]	Dimensions													Mating dim.	
			d -0,005	D	B -0,25	D <sub>1</sub>	B <sub>1</sub>	J	d <sub>2</sub>	l	m	n	A	d <sub>1</sub>	d	D <sub>a</sub> <sup>6)</sup>	d <sub>a</sub> <sup>6)</sup>
6	ZKLFA0630.2Z	0.05	6	19	12	30	5	24	3.5	—	21	12	22	12	30	—	9
	ZKLFA0640.2RS	0.08	6	24	15	40	6	32	4.5	—	27.5	16	27	14	40	—	9
	ZKLFA0640.2Z	0.08	6	24	15	40	6	32	4.5	—	27.5	16	27	14	40	—	9
8	ZKLFA0850.2RS	0.17	8	32	20	50	8	40	5.5	—	34.5	20	35	19	50	—	12
	ZKLFA0850.2Z	0.17	8	32	20	50	8	40	5.5	—	34.5	20	35	19	50	—	12
10	ZKLFA1050.2RS	18	10	32	20	50	8	40	5.5	—	34.5	20	35	21	50	—	14
	ZKLFA1050.2Z	18	10	32	20	50	8	40	5.5	—	34.5	20	35	21	50	—	14
12	ZKLFA1263.2RS	0.3	12	42	25	63	10	53	6.5	—	46	26.5	45	25	63	—	16
	ZKLFA1263.2Z	0.3	12	42	25	63	10	53	6.5	—	46	26.5	45	25	63	—	16
15	ZKLFA1563.2RS	0.31	15	42	25	63	10	53	6.5	—	46	26.5	45	28	63	—	20
	ZKLFA1563.2Z	0.31	15	42	25	63	10	53	6.5	—	46	26.5	45	28	63	—	20

Table 7.36 **Technical data of angular ball bearing unit ZKLFA**

Shaft diameter	Code	Retaining bolts DIN912 10.9 <sup>2)</sup>		Axial load rating		Limit speed	Bearing friction torque <sup>3)</sup>	Axial rigidity	Resistance to tilting	Recommended lock nut <sup>2)</sup>	Tightening torque <sup>2)</sup>
			Anzahl n × t	C <sub>dyn</sub> [kN]	C <sub>0</sub> [kN]	Fett [1/min]	M <sub>RL</sub> [Nm]	c <sub>aL</sub> [N/µm]	c <sub>kL</sub> [Nm/mrad]	Artikel- nummer	MA [Nm]
6	ZKLFA0630.2Z	M3	4	4.9	6.1	14000	0.01	150	4	HIR06	2
	ZKLFA0640.2RS	M4	4	6.9	8.5	6800	0.02	200	8	HIR06	2
	ZKLFA0640.2Z	M4	4	6.9	8.5	12000	0.02	200	8	HIR06	2
8	ZKLFA0850.2RS	M5	4	12.5	16.3	5100	0.04	250	20	HIR08	4
	ZKLFA0850.2Z	M5	4	12.5	16.3	9500	0.04	250	20	HIR08	4
10	ZKLFA1050.2RS	M5	4	13.4	18.8	4600	0.06	325	25	HIR10	6
	ZKLFA1050.2Z	M5	4	13.4	18.8	8600	0.06	325	25	HIR10	6
12	ZKLFA1263.2RS	M6	4	17	24.7	3800	0.08	375	50	HIR12	8
	ZKLFA1263.2Z	M6	4	17	24.7	7600	0.08	375	50	HIR12	8
15	ZKLFA1563.2RS	M6	4	17,9	28	3500	0,1	400	65	HIR15	10
	ZKLFA1563.2Z	M6	4	17,9	28	7000	0,1	400	65	HIR15	10

The ball cages are made from plastic, permissible operating temperature 120 °C (continuous operation)

1) Contact angle  $\alpha = 60^\circ$ .

2) Tightening torque of retaining bolts according to details from manufacturer.

Screws according to DIN 912 are not supplied.

3) Bearing friction torque with gap seal (.2Z). With sealing disc (.2RS)  $\approx 2 \times M_{RL}$ .

4) min.  $r_s = 0.3$  mm.

5) min.  $r_{1s} = 0.6$  mm; min.  $r_{1s} = 0.3$  mm.

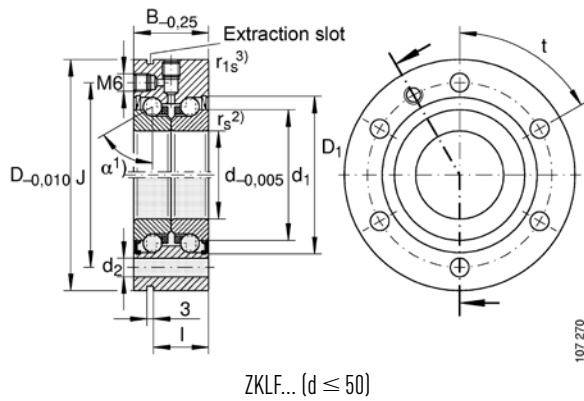
6) Minimum diameter required of installation surface. If these diameters are not reached,

$D_1$  and  $d_1$  should be noted.

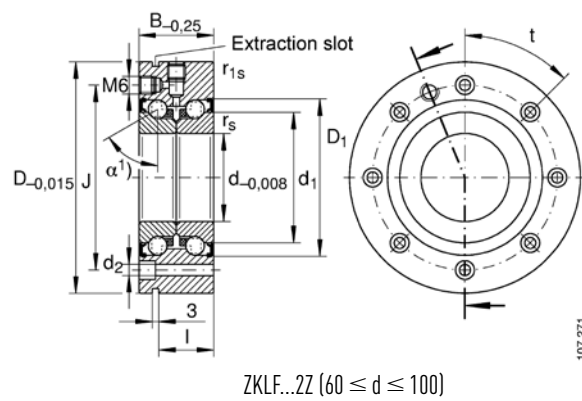
**Bearing design:**

The minimum height of the shaft and housing shoulder to be noted for the connecting dimensions can be found in the dimensions table for bearings of the ZKLN and ZKLF series.

The tolerances required of the shaft and housing surface properties for bearings of the ZKLN and ZKLF series are shown in the figures.



ZKLF... (d ≤ 50)



ZKLF...2Z (60 ≤ d ≤ 100)

Table 7.37 Dimensions and connecting dimensions for angular ball bearing unit ZKLF

Shaft diam- eter	Code	Weight [kg]	Dimensions													Mating dimensions	
			d -0,005	D	B -0,25	D <sub>1</sub>	B <sub>1</sub>	J	d <sub>2</sub>	l	m	n	A	d <sub>1</sub>	d	D <sub>a</sub> <sup>4)</sup>	d <sub>a</sub> <sup>4)</sup>
12	ZKLF1255.2Z	0,37	12	55	25	—	—	42	6,5	17	—	—	—	25	33,5	33	16
	ZKLF1255.2RS*	0,37	12	55	25	—	—	42	6,5	17	—	—	—	25	33,5	33	16
15	ZKLF1560.2Z	0,43	15	60	25	—	—	46	6,5	17	—	—	—	28	36	35	20
	ZKLF1560.2RS*	0,43	15	60	25	—	—	46	6,5	17	—	—	—	28	36	35	20
17	ZKLF1762.2Z	0,45	17	62	25	—	—	48	6,5	17	—	—	—	30	38	37	23
	ZKLF1762.2RS*	0,45	17	62	25	—	—	48	6,5	17	—	—	—	30	38	37	23
20	ZKLF2068.2Z	0,61	20	68	28	—	—	53	6,5	19	—	—	—	34,5	44	43	25
	ZKLF2068.2RS*	0,61	20	68	28	—	—	53	6,5	19	—	—	—	34,5	44	43	25
25	ZKLF2575.2Z	0,72	25	75	28	—	—	58	6,5	19	—	—	—	40,5	49	48	32
	ZKLF2575.2RS	0,72	25	75	28	—	—	58	6,5	19	—	—	—	40,5	49	48	32
30	ZKLF3080.2Z	0,78	30	80	28	—	—	63	6,5	19	—	—	—	45,5	54	53	40
	ZKLF3080.2RS*	0,78	30	80	28	—	—	63	6,5	19	—	—	—	45,5	54	53	40
30	ZKLF30100.2Z	1,63	30	100	38	—	—	80	8,5	30	—	—	—	51	65	64	47
	ZKLF30100.2RS	1,63	30	100	38	—	—	80	8,5	30	—	—	—	51	65	64	47
35	ZKLF3590.2Z	1,13	35	90	34	—	—	75	8,5	25	—	—	—	52	63	62	45
	ZKLF3590.2RS*	1,13	35	90	34	—	—	75	8,5	25	—	—	—	52	63	62	45
40	ZKLF40100.2Z	1,46	40	100	34	—	—	80	8,5	25	—	—	—	58	68	67	50
	ZKLF40100.2RS*	1,46	40	100	34	—	—	80	8,5	25	—	—	—	58	68	67	50
40	ZKLF40115.2Z	2,2	40	115	46	—	—	94	8,5	36	—	—	—	65	80	80	56
	ZKLF40115.2RS	2,2	40	115	46	—	—	94	8,5	36	—	—	—	65	80	80	56
50	ZKLF50115.2Z	1,86	50	115	34	—	—	94	8,5	25	—	—	—	72	82	82	63
	ZKLF50115.2RS*	1,86	50	115	34	—	—	94	8,5	25	—	—	—	72	82	82	63
50	ZKLF50140.2Z	4,7	50	140	54	—	—	113	10,5	45	—	—	—	80	98	98	63
	ZKLF50140.2RS	4,7	50	140	54	—	—	113	10,5	45	—	—	—	80	98	98	63
60	ZKLF60145.2Z	4,3	60	145	45	—	—	120	8,5	35	—	—	—	85	100	100	82
70	ZKLF70155.2Z	4,9	70	155	45	—	—	130	8,5	35	—	—	—	95	110	110	92
80	ZKLF80165.2Z	5,3	80	165	45	—	—	140	8,5	35	—	—	—	105	120	120	102
90	ZKLF90190.2Z	8,7	90	190	55	—	—	165	10,5	45	—	—	—	120	138	138	116
100	ZKLF100200.2Z	9,3	100	200	55	—	—	175	10,5	45	—	—	—	132	150	150	128

The ball cages are made from plastic, permissible operating temperature 120 °C (continuous operation)

1) Contact angle  $\alpha = 60^\circ$ .

2) min.  $r_s = 0.3$  mm.

3) min.  $r_{1s} = 0.6$  mm; min.  $r_{1s} = 0.3$  mm.

4) Minimum diameter required of installation surface. If these diameters are not reached,  $D_1$  and  $d_1$  should be noted.

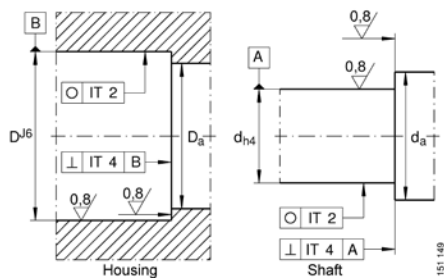
#### Bearing design:

The minimum height of the shaft and housing shoulder to be noted for the connecting dimensions can be found in the dimensions table for bearings of the ZKLN and ZKLF series.

The tolerances required of the shaft and housing surface properties for bearings of the ZKLN and ZKLF series are shown in the figures.

# Ballscrews

## Accessories



Housing and shaft tolerances ZKLF...

Table 7.38 **Technical data of angular ball bearing unit ZKLF**

Shaft diameter	Code	Retaining bolts DIN912 10.9 <sup>2)</sup>		Axial load rating		Limit speed	Bearing friction torque <sup>2)</sup>	Axial rigidity	Resistance to tilting	Recommended lock nut <sup>1)</sup>	Tightening torque <sup>1)</sup>
			Quantity n × t	C <sub>dyn</sub> [kN]	C <sub>0</sub> [kN]	Grease [min. 1]	M <sub>RL</sub> [Nm]	C <sub>aL</sub> [N/μm]	C <sub>kL</sub> [Nm/mrad]	Article number	MA [Nm]
12	ZKLF1255.2Z	M6	3 × 120°	17	24.7	7600	0.08	375	50	HIR12	8
	ZKLF1255.2RS*	M6	3 × 120°	17	24.7	3800	0.08	375	50	HIR12	8
15	ZKLF1560.2Z	M6	3 × 120°	17.9	28	7000	0.1	400	65	HIR15	10
	ZKLF1560.2RS*	M6	3 × 120°	17.9	28	3500	0.1	400	65	HIR15	10
17	ZKLF1762.2Z	M6	3 × 120°	18.8	31	6600	0.12	450	80	HIR17/HIA17	15
	ZKLF1762.2RS*	M6	3 × 120°	18.8	31	3300	0.12	450	80	HIR17/HIA17	15
20	ZKLF2068.2Z	M6	4 × 90°	26	47	5400	0.15	650	140	HIR20/HIA20	18
	ZKLF2068.2RS*	M6	4 × 90°	26	47	3000	0.15	650	140	HIR20/HIA20	18
25	ZKLF2575.2Z	M6	4 × 90°	27.5	55	4700	0.2	750	200	HIR25/HIA25	25
	ZKLF2575.2RS	M6	4 × 90°	27.5	55	2600	0.2	750	200	HIR25/HIA25	25
30	ZKLF3080.2Z	M6	6 × 60°	29	64	4300	0.25	850	300	HIR30/HIA30	32
	ZKLF3080.2RS*	M6	6 × 60°	29	64	2200	0.25	850	300	HIR30/HIA30	32
30	ZKLF30100.2Z	M8	8 × 45°	59	108	4000	0.4	950	400	HIA30	65
	ZKLF30100.2RS	M8	8 × 45°	59	108	2100	0.4	950	400	HIA30	65
35	ZKLF3590.2Z	M8	4 × 90°	41	89	3800	0.3	900	400	HIR35/HIA35	40
	ZKLF3590.2RS*	M8	4 × 90°	41	89	2000	0.3	900	400	HIR35/HIA35	40
40	ZKLF40100.2Z	M8	4 × 90°	43	101	3300	0.35	1000	555	HIR40/HIA40	55
	ZKLF40100.2RS*	M8	4 × 90°	43	101	1800	0.35	1000	555	HIR40/HIA40	55
40	ZKLF40115.2Z	M8	12 × 30°	72	149	3100	0.65	1200	750	HIA40	110
	ZKLF40115.2RS	M8	12 × 30°	72	149	1600	0.65	1200	750	HIA40	110
50	ZKLF50115.2Z	M8	6 × 60°	46.5	126	3000	0.45	1250	1000	HIR50/HIA50	85
	ZKLF50115.2RS*	M8	6 × 60°	46.5	126	1500	0.45	1250	1000	HIR50/HIA50	85
50	ZKLF50140.2Z	M10	12 × 30°	113	250	2500	1.3	1400	1500	HIA50	150
	ZKLF50140.2RS	M10	12 × 30°	113	250	1200	1.3	1400	1500	HIA50	150
60	ZKLF60145.2Z	M8	8 × 45°	84	214	2400	1	1300	1650	HIR60/HIA60	100
70	ZKLF70155.2Z	M8	8 × 45°	88	241	2200	1.2	1450	2250	HIR70/HIA70	130
80	ZKLF80165.2Z	M8	8 × 45°	91	265	2100	1.4	1575	3000	HIR80/HIA80	160
90	ZKLF90190.2Z	M10	8 × 45°	135	395	1800	2.3	1700	4400	HIA90	200
100	ZKLF100200.2Z	M10	8 × 45°	140	435	1700	2.6	1900	5800	HIA100	250

The ball cages are made from plastic, permissible operating temperature 120 °C (continuous operation)

1) Tightening torque of retaining bolts according to details from manufacturer.

Screws according to DIN 912 are not supplied.

2) Bearing friction torque with gap seal (.2Z). With sealing disc (.2RS) ≈ 2 × M<sub>RL</sub>.

### Bearing design:

The minimum height of the shaft and housing shoulder to be noted for the connecting dimensions can be found in the dimensions table for bearings of the ZKLN and ZKLF series.

The tolerances required of the shaft and housing surface properties for bearings of the ZKLN and ZKLF series are shown in the figures.

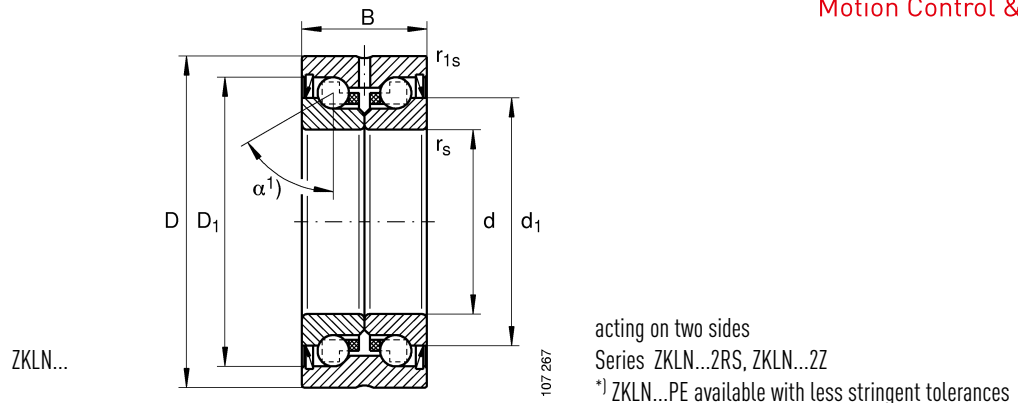


Table 7.39 Dimensions and connecting dimensions for angular ball bearing unit ZKLN

Shaft diameter	Code	Weight	Dimensions							Connecting dim.	
			d -0,005 <sup>2)</sup>	D -0,01 <sup>3)</sup>	B -0,25	rs min.	r1s min.	d1	D1	Da <sup>4)</sup>	da <sup>4)</sup>
6	ZKLN0619.2Z	0.02	6	19	12	0.3	0.3	12	16.5	16	9
	ZKLN0624.2RS*	0.03	6	24	15	0.3	0.6	14	19.5	19	9
	ZKLN0624.2Z	0.03	6	24	15	0.3	0.6	14	19.5	19	9
8	ZKLN0832.2RS	0.09	8	32	20	0.3	0.6	19	26.5	26	12
	ZKLN0832.2Z	0.09	8	32	20	0.3	0.6	19	26.5	26	12
10	ZKLN1034.2RS*	0.1	10	34	20	0.3	0.6	21	28.5	28	14
	ZKLN1034.2Z	0.1	10	34	20	0.3	0.6	21	28.5	28	14
12	ZKLN1242.2RS*	0.2	12	42	25	0.3	0.6	25	33.5	33	16
	ZKLN1242.2Z	0.2	12	42	25	0.3	0.6	25	33.5	33	16
15	ZKLN1545.2RS*	0.21	15	45	25	0.3	0.6	28	36	35	20
	ZKLN1545.2Z	0.21	15	45	25	0.3	0.6	28	36	35	20
17	ZKLN1747.2RS*	0.22	17	47	25	0.3	0.6	30	38	37	23
	ZKLN1747.2Z	0.22	17	47	25	0.3	0.6	30	38	37	23
20	ZKLN2052.2RS*	0.31	20	52	28	0.3	0.6	34.5	44	43	25
	ZKLN2052.2Z	0.31	20	52	28	0.3	0.6	34.5	44	43	25
25	ZKLN2557.2RS*	0.34	25	57	28	0.3	0.6	40.5	49	48	32
	ZKLN2557.2Z	0.34	25	57	28	0.3	0.6	40.5	49	48	32
30	ZKLN3062.2RS*	0.39	30	62	28	0.3	0.6	45.5	54	53	40
	ZKLN3062.2Z	0.39	30	62	28	0.3	0.6	45.5	54	53	40
30	ZKLN3072.2RS	0.72	30	72	38	0.3	0.6	51	65	64	47
	ZKLN3072.2Z	0.72	30	72	38	0.3	0.6	51	65	64	47
35	ZKLN3572.2RS*	0.51	35	72	34	0.3	0.6	52	63	62	45
	ZKLN3572.2Z	0.51	35	72	34	0.3	0.6	52	63	62	45
40	ZKLN4075.2RS*	0.61	40	75	34	0.3	0.6	58	68	67	50
	ZKLN4075.2Z	0.61	40	75	34	0.3	0.6	58	68	67	50
40	ZKLN4090.2RS	0.95	40	90	46	0.6	0.6	65	80	80	56
	ZKLN4090.2Z	0.95	40	90	46	0.6	0.6	65	80	80	56
50	ZKLN5090.2RS*	0.88	50	90	34	0.3	0.6	72	82	82	63
	ZKLN5090.2Z	0.88	50	90	34	0.3	0.6	72	82	82	63
	ZKLN50110.2RS	2.5	50	110	54	0.6	0.6	80	98	98	63
	ZKLN50110.2Z	2.5	50	110	54	0.6	0.6	80	98	98	63
60	ZKLN60110.2Z	2.2	60	110	45	0.6	0.6	85	100	100	85
70	ZKLN70120.2Z	2.4	70	120	45	0.6	0.6	95	110	110	92
80	ZKLN80130.2Z	2.7	80	130	45	0.6	0.6	105	120	120	102
90	ZKLN90150.2Z	4.5	90	150	55	0.6	0.6	120	138	138	116
100	ZKLN100160.2Z	4.9	100	160	55	0.6	0.6	132	150	150	128

The ball cages are made from plastic, permissible operating temperature 120 °C (continuous operation)

1) Contact angle  $\alpha = 60^\circ$ .

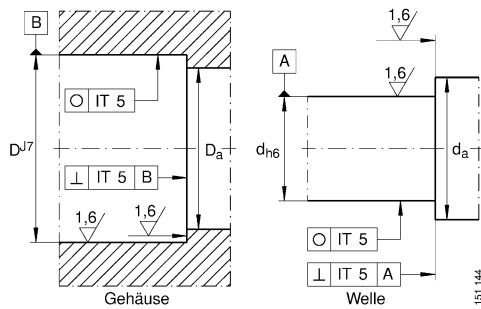
2) Hole diameter tolerance as of  $d = 60 \text{ mm } d_{-0.008}^*$

3) Outer diameter tolerance as of  $d = 60 \text{ mm } d_{-0.015}^*$

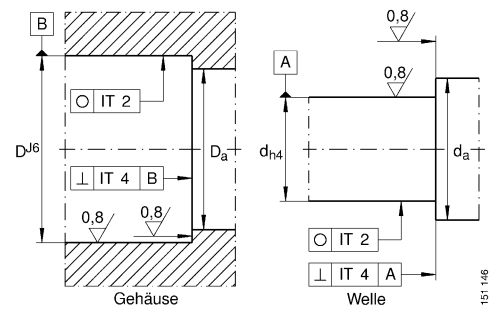
4) Minimum diameter required of installation surface. If these diameters are not reached, the diameters  $D_1$  and  $d_1$  should be noted.

# Kugelgewindetriebe

## Zubehör



Housing and shaft tolerances ZKLN...2RSPE



Housing and shaft tolerances ZKLN...2RS/...2Z

Table 7.40 Technical data of angular ball bearing unit ZKLN

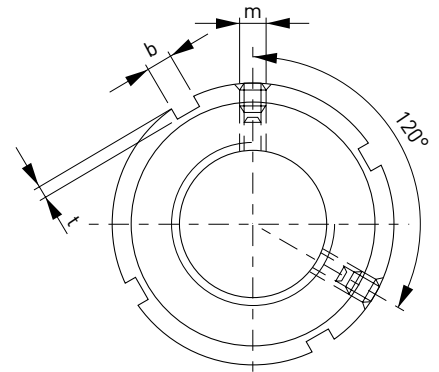
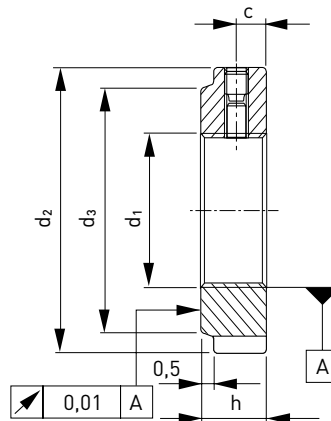
Code	Axial load rating		Limit speed	Bearing friction torque <sup>1)</sup>	Axial rigidity	Resistance to tilting	Recommended lock nut <sup>2)</sup>	Tightening torque <sup>2)</sup>	Shaft diameter
	C <sub>dyn</sub> [kN]	C <sub>0</sub> [kN]	Fett [min.]	M <sub>RL</sub> [Nm]	C <sub>aL</sub> [N/μm]	C <sub>kL</sub> [Nm/mrad]	Article number	M <sub>A</sub> [Nm]	[mm]
ZKLN0619.2Z	4.9	6.1	14000	0.01	150	4	HIR6	2	6
ZKLN0624.2RS*	6.9	8.5	6800	0.02	200	8	HIR6	2	—
ZKLN0624.2Z	6.9	8.5	12000	0.02	200	8	HIR6	2	—
ZKLN0832.2RS	12.5	16.3	5100	0.04	250	20	HIR8	4	8
ZKLN0832.2Z	12.5	16.3	9500	0.04	250	20	HIR8	4	—
ZKLN1034.2RS*	13.4	18.8	4600	0.06	325	25	HIR10	6	10
ZKLN1034.2Z	13.4	18.8	8600	0.06	325	25	HIR10	6	—
ZKLN1242.2RS*	17	24.7	3800	0.08	375	50	HIR12	8	12
ZKLN1242.2Z	17	24.7	7600	0.08	375	50	HIR12	8	—
ZKLN1545.2RS*	17.9	28	3500	0.1	400	65	HIR15	10	15
ZKLN1545.2Z	17.9	28	7000	0.1	400	65	HIR15	10	—
ZKLN1747.2RS*	18.8	31	3300	0.12	450	80	HIR17/HIA17	15	17
ZKLN1747.2Z	18.8	31	6600	0.12	450	80	HIR17/HIA17	15	—
ZKLN2052.2RS*	26	47	3000	0.15	650	140	HIR20/HIA20	18	20
ZKLN2052.2Z	26	47	5400	0.15	650	140	HIR20/HIA20	18	—
ZKLN2557.2RS*	27.5	55	2600	0.2	750	200	HIR25/HIA25	25	25
ZKLN2557.2Z	27.5	55	4700	0.2	750	200	HIR25/HIA25	25	—
ZKLN3062.2RS*	29	64	2200	0.25	850	300	HIR30/HIA30	32	30
ZKLN3062.2Z	29	64	4300	0.25	850	300	HIR30/HIA30	32	—
ZKLN3072.2RS	59	108	2100	0.4	950	400	—	—	—
ZKLN3072.2Z	59	108	4000	0.4	950	400	—	—	—
ZKLN3572.2RS*	41	89	2000	0.3	900	400	HIR35/HIA35	40	35
ZKLN3572.2Z	41	89	3800	0.3	900	400	HIR35/HIA35	40	—
ZKLN4075.2RS*	43	101	1800	0.35	1000	555	HIR40/HIA40	55	40
ZKLN4075.2Z	43	101	3300	0.35	1000	555	HIR40/HIA40	55	—
ZKLN4090.2RS	72	149	1600	0.65	1200	750	—	—	—
ZKLN4090.2Z	72	149	3100	0.65	1200	750	—	—	—
ZKLN5090.2RS*	46.5	126	1500	0.45	1250	1000	HIR50/HIA50	85	50
ZKLN5090.2Z	46.5	126	3000	0.45	1250	1000	HIR50/HIA50	85	—
ZKLN50110.2RS	113	250	1200	1.3	1400	1500	—	—	—
ZKLN50110.2Z	113	250	2500	1.3	1400	1500	—	—	—
ZKLN60110.2Z	84	214	2400	1	1300	1650	HIR60/HIA60	100	60
ZKLN70120.2Z	88	241	2200	1.2	1450	2250	HIR70/HIA70	130	70
ZKLN80130.2Z	91	265	2100	1.4	1575	3000	HIR80/HIA80	160	80
ZKLN90150.2Z	135	395	1800	2.3	1700	4400	HIR90/HIA90	200	90
ZKLN100160.2Z	140	435	1700	2.6	1900	5800	HIR100/HIA100	250	100

1) Bearing friction torque with gap seal (.2Z). With seal disc (.2RS)  $\approx 2 \times M_{RL}$ .

2) Lock nuts are not supplied; order separately!



### 7.9 HIR lock nuts, radial clamping



The applications for lock nuts range from general machine construction, precision machine tools and measuring machines to wood processing machines and industrial robots.

Our lock nuts HIR and HIA have an advanced clamping system. Should a lock nut block, it can now be loosened again either when assembling your machine or during customer service and repairs.

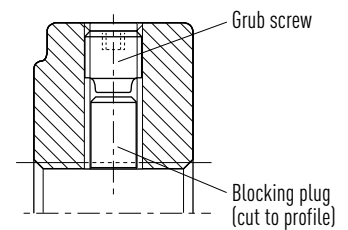


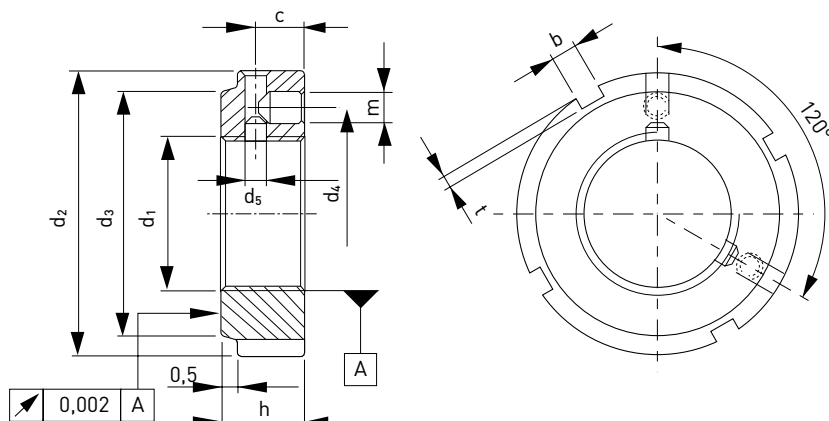
Table 7.41 Dimensions of lock nut HIR

Article number	Thread $d_1$	$d_2$	$h$	$b$	$t$	$d_3$	$c$	$m$
HIR08	M 8 × 0.75	16	8	3	2	11	4	M4
HIR10	M 10 × 0.75	18	8	3	2	13	4	M4
HIR12	M 12 × 1	22	8	3	2	18	4	M4
HIR15	M 15 × 1	25	8	3	2	21	4	M4
HIR17	M 17 × 1	28	10	4	2	23	5	M5
HIR20 × 1	M 20 × 1	32	10	4	2	27	5	M5
HIR20 × 1.5	M 20 × 1.5	32	10	4	2	27	5	M5
HIR25	M 25 × 1.5	38	12	5	2	33	6	M6
HIR30	M 30 × 1.5	45	12	5	2	40	6	M6
HIR35	M 35 × 1.5	52	12	5	2	47	6	M6
HIR40	M 40 × 1.5	58	14	6	2.5	52	7	M6
HIR45	M 45 × 1.5	65	14	6	2.5	59	7	M6
HIR50	M 50 × 1.5	70	14	6	2.5	64	7	M6
HIR55	M 55 × 2	75	16	7	3	68	8	M6
HIR60	M 60 × 2	80	16	7	3	73	8	M6
HIR65	M 65 × 2	85	16	7	3	78	8	M6
HIR70	M 70 × 2	92	18	8	3.5	85	9	M8
HIR75	M 75 × 2	98	18	8	3.5	90	9	M8
HIR80	M 80 × 2	105	18	8	3.5	95	9	M8
HIR85	M 85 × 2	110	18	8	3.5	102	9	M8
HIR90	M 90 × 2	120	20	10	4	108	10	M8
HIR95	M 95 × 2	125	20	10	4	113	10	M8
HIR100	M 100 × 2	130	20	10	4	120	10	M8

# Ballscrews

## Accessories/additional information

### 7.10 HIA lock nuts, axial clamping



#### Type

Right-hand thread,

left-hand thread on request.

The thread and plane surface are produced in a single clamping process.

Thread quality 4H.

HIR and HIA lock nuts can be used several times if used correctly.

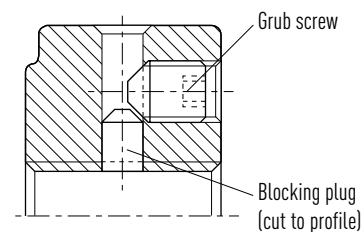


Table 7.42 Dimensions of lock nuts HIA

Article number	Thread $d_1$	$d_2$	$h$	$b$	$t$	$d_3$	$d_4$	$m$
HIA17	M 17 × 1	28	16	4	2	23	22.5	M4
HIA20 × 1	M 20 × 1	32	16	4	2	27	26	M4
HIA20 × 1.5	M 20 × 1.5	32	16	4	2	27	26	M4
HIA25	M 25 × 1.5	38	18	5	2	33	31.5	M5
HIA30	M 30 × 1.5	45	18	5	2	40	37.5	M5
HIA35	M 35 × 1.5	52	18	5	2	47	43.5	M5
HIA40	M 40 × 1.5	58	20	6	2.5	52	49	M6
HIA45	M 45 × 1.5	65	20	6	2.5	59	55	M6
HIA50	M 50 × 1.5	70	20	6	2.5	64	60	M6
HIA55	M 55 × 2	75	22	7	3	68	65	M6
HIA60	M 60 × 2	80	22	7	3	73	70	M6
HIA65	M 65 × 2	85	22	7	3	78	75	M6
HIA70	M 70 × 2	92	24	8	3.5	85	81	M8
HIA75	M 75 × 2	98	24	8	3.5	90	87	M8
HIA80	M 80 × 2	105	24	8	3.5	95	93	M8
HIA85	M 85 × 2	110	24	8	3.5	102	98	M8
HIA90	M 90 × 2	120	26	10	4	108	105	M8
HIA95	M 95 × 2	125	26	10	4	113	110	M8
HIA100	M 100 × 2	130	26	10	4	120	115	M8

## 8. Additional information

### 8.1 Troubleshooting and error elimination

#### Introduction

Over the last few years, ballscrews have increasingly been used in all applications requiring great accuracy and improved performance. Ballscrews are the most commonly used of all power transmission components. Thanks to ballscrews, CNC machines achieve greater accuracy and longer lives. They have increasingly taken the place of trapezoid screw drives in manually operated machines.

Ballscrews with a little play are used in most applications to prevent system redundancy. If good accuracy is needed, it may be a good idea to use preloaded ballscrews. HIWIN can supply ballscrews individually preloaded to your requirements. This chapter explains potential ballscrew malfunctions and how to avoid them. It also introduces several measuring devices which allow the user to localise the causes of excess clearance.

### 8.2 Causes of errors and error prevention

The main sources of error can be split into four categories:

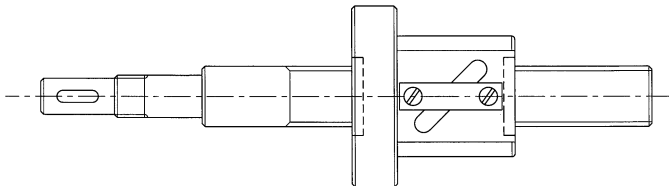
#### 8.2.1 Excessive play

##### No preload or insufficient preload:

If the ballscrew is held vertically and the nut can be pulled down under its own weight and rotated around the shaft, the ballscrew has play or is slightly preloaded. Ballscrews without preload may have significant axial backlash; they are therefore used in applications which do not primarily require high accuracy levels.

HIWIN establishes the preload needed for the application and supplies the ballscrew with the necessary preload. A detailed and accurate description of the usage conditions is therefore very important for HIWIN ballscrew orders.

Fig. 8.1 Structure of a ballscrew

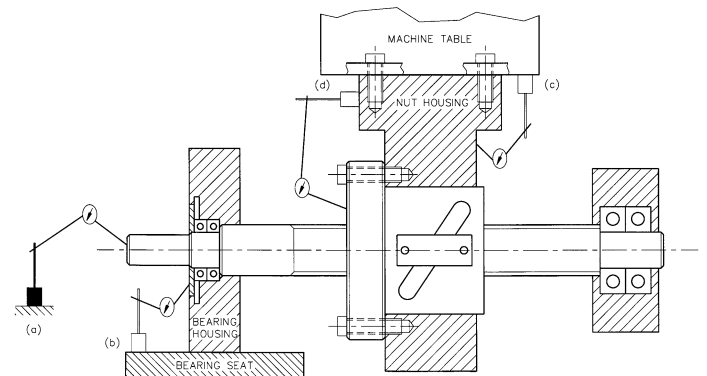


The following measurements can be taken to establish the reason behind abnormal play in the ballscrew:

1. Glue ball gauge in central hole at one end of ballscrew shaft. Use a dial gauge to measure the axial backlash of the ball gauge as you rotate the ballscrew shaft (Fig. 8.2(a)). It should not move any more than 0.003 mm if the bearing, ballscrew nut and nut housing are fitted correctly.
2. Use a dial gauge to measure the relative movement between the bearing housing and bearing seat as you rotate the ballscrew shaft (Fig. 8.2(b)). Any measurement other than zero shows that the bearing is either not rigid enough or incorrectly mounted.
3. Check relative movement between machine bed and housing of ballscrew nut. (Fig. 8.2(c)).
4. Check relative movement between housing of ballscrew nut and flange (Fig. 8.2(d)).

Contact HIWIN if the tests described do not yield anything but play is still present. The preload or rigidity of the ballscrew may have to be increased.

Fig. 8.2 Establishing reason for abnormal play



### 8.2.2 Excess torsional deformation

1. **Incorrect choice of material:**

Table 2.13 is an overview of the materials to be used in ballscrews for shafts and nuts.

2. **Incorrect heat treatment:**

Depth of heat-treated layer too shallow, uneven surface heat treatment, material too soft: The standard hardnesses for balls, nuts and shafts for ballscrews are HRC 62 – 66, 56 – 62 and 56 – 62.

3. **Design errors, ratio of length to diameter too large etc.:**

The smaller the ratio of shaft length to diameter (L/D figure), the greater the rigidity. The recommended L/D figure is less than 60 (Table 2.14 shows the relationship between accuracy and L/D figure). Too high an L/D figure may result in significant torsional deformation. Wherever possible, assembly with bearings on one side should be avoided.

4. **Incorrect choice of bearings:**

Ballscrews should be mounted with angular ball bearings; angular ball bearings designed especially for ballscrews are recommended in particular. When axial loads occur, normal ball bearings display considerable axial backlash; such bearings should not therefore be used for applications with axial loads.

5. **Nut housing or bearing housing is not rigid enough**

The housing mounted on the ballscrew nut or on a bearing may twist under the weight of the components or machine load if not rigid enough. The test structure shown in Fig. 8.2(d) can be used to test the rigidity of the nut housing. Similar test structures can be used to test the rigidity of bearing housings.

6. **Nut housing or bearing housing is not mounted correctly**

- Vibration or a lack of dowel pins may cause the components to come loose. Fixed dowel pins and not clamping pins should be used to lock.
- The screw connection on the ballscrew nut is not secure because the screws are too long and/or the threaded holes on the housing are too short.
- Vibration and a lack of circlips causes the screws on the ballscrew nut to come loose.

7. **Housing surface is not parallel or flat enough**

When the machine is assembled, spacers are often fitted between the housing and machine frame for adjustment. The dimensions of the mounting surface may vary at different points if the surface parallelism or evenness of the components is not within tolerance.

8. **Motor and ballscrew are not fitted correctly**

- If the coupling is not fitted securely or is not rigid enough, relative rotation results between the motor shaft and ballscrew shaft.
- Gear teeth do not mesh correctly or the driveline is not rigid enough. If the ballscrew is driven by a belt, a toothed belt should be used to avoid slipping.
- Feather key is loose in groove. Any incorrect combination of shaft, groove and feather key may cause play.

### 8.2.3 Uneven running

1. **Production-related defects on ballscrew**

- The race profile on the ballscrew shaft or nut is too rough.
  - The bearing balls, ballscrew nut or shaft are out of round.
  - The lead or lead circle diameter of ballscrew nut or shaft are outside tolerance.
  - The ball return is not correctly fitted in the ballscrew nut.
  - Uneven ball size or hardness.
- These problems should not arise with high-quality manufacturers.

2. **Foreign objects in ball race profile**

- Packaging material jammed in ball race profile. Before being shipped, ballscrews are packaged with various packaging materials and oil paper. These materials and other objects may jam in the ball race profile if care is not exercised when assembling and aligning the ballscrew. This may cause the balls to slide rather than roll or even jam completely.
- Machine chips enter the ball track. Chips or dust from machine operations may enter the ball track if wipers are not used to keep items away from the ballscrew's race profiles. This causes uneven running, reduced accuracy and a shortened life.

3. **Operation beyond the maximum useful path**

Travel beyond the maximum useful path may damage or even destroy the recirculation system. If this happens, the balls are no longer able to circulate evenly. In the worst cases, they may break and the race profile on the ballscrew shaft or nut be damaged. Operation beyond the maximum useful path may occur when setting up, as a result of limit switch failure or due to collisions in the machine. To avoid further damage, after exceeding the path, a ballscrew must be checked and repaired by the manufacturer before being used again.

4. **Ball return damaged**

The ball return may be damaged and cause the problems described above if it experiences severe impact during assembly.

#### 5. Incorrect alignment

If the axles of the ballscrew nut housing and the shaft bearing don't fully match, radial load occurs. The ballscrew may bend if the load is excessive. Even if the axle error is so minor as to cause no discernible bending, it will still cause increased wear. If incorrectly aligned, the ballscrew accuracy will quickly deteriorate. The greater the ballscrew nut preload, the greater the need for the ballscrew to be accurately aligned.

#### 6. Ballscrew nut not correctly mounted on housing

If the ballscrew nut is mounted at an angle or poorly aligned, eccentric loads occur. If this happens, the motor input current may fluctuate during operation.

#### 7. Transport damage to ballscrew

### 8.2.4 Breakage

#### 1. Broken ball

Cr-Mo steel is the material most commonly used for bearing balls. A load of 1400 – 1600 kg is needed to break a ball with a diameter of 3.175 mm. The temperature of a ball with insufficient or no lubrication rises continuously during operation. This increase in temperature can make the balls brittle and cause them to break, which then results in damage to the race profile in the ballscrew nut and on the shaft. The process of topping up lubricant should therefore be taken into account at the design stage. If an automatic lubrication system cannot be used, regular lubricant top-ups should be included in the maintenance schedule.

#### 2. Pressed-in or broken ball return

If the ballscrew nuts travel beyond the permissible path or impact against the ball return, the return may be pressed in or broken. This blocks the path for the balls, so they simply slide and ultimately break.

#### 3. Bearing journal breakage on shaft

##### ○ Incorrect design:

Sharp edges should be avoided on the shaft's bearing journal to avoid local peaks in stress. (Fig. 8.3) shows useful design features for the bearing journal.

##### ○ Bending strain on the bearing journal:

The bearing's mounting surface and the bearing lug's axle are not perpendicular to one another or the opposite sides of the bearing lug are not parallel to one another. The bearing journal is thereby bent and may ultimately break. The deviation in the bearing journal position before and after the bearing lug is tightened should not exceed 0.01 mm.

##### ○ Radial load or load fluctuations:

Incorrect alignment during ballscrew assembly causes abnormal fluctuating shearing loads and therefore premature ballscrew failure.

Fig. 8.3 Recesses for avoiding peaks in stress

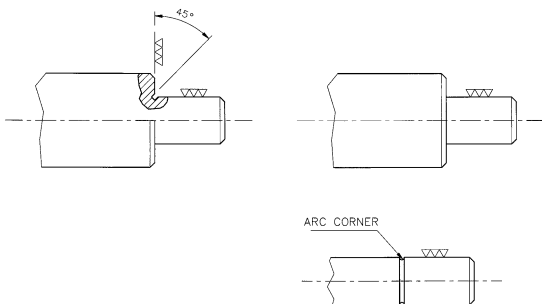
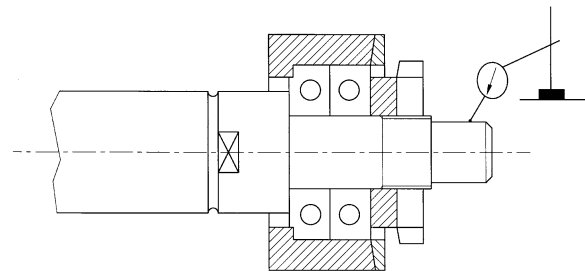
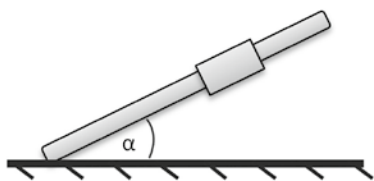


Fig. 8.4 Concentricity check on drive journal



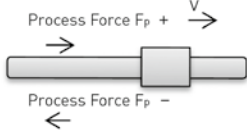
### 9. Project planning sheet

Customer Data	
Company:	Contact Person:
	Department:
	Phone:
Project:	Fax:
	Email:

Mounting Position	System Parameters	
 <p> <math>\alpha = 0^\circ</math>    horizontal    <input type="checkbox"/>  <math>\alpha = 90^\circ</math>    vertical    <input type="checkbox"/>  <math>\alpha = \_\_\_\circ</math> </p>	Nut type	
	Ballscrew diameter $d_s$ [mm]	
	Lead $P$ [mm]	
	Total length $l_g$ [mm]	
	Load $m$ [kg]	
	Unsupported shaft length $l_k$ [mm]	
	Preload in percent [%]	
	Friction force $F_R$ [N]	
	Other information:	

Type of bearing	Lubrication	Operating temperature
Fixed – Fixed <input type="checkbox"/> Fixed – Supported <input type="checkbox"/> Supported – Supported <input type="checkbox"/> Fixed – Free <input type="checkbox"/>	Oil <input type="checkbox"/> Grease <input type="checkbox"/>	min. °C    max. °C <b>Special operating conditions</b> (e.g. dust, chips, fluid)

Cycle data							
Phase n	Direction of motion, see (1)	Process force $F_P$ [N], see (2)	Acceleration $a$ [m/s <sup>2</sup> ]	Deceleration $a$ [m/s <sup>2</sup> ]	Rotation speed [1/min]		Time slice [%]
					$n_1$	$n_2$	
1							
2							
3							
4							
5							
6							
7							
8							
9							

Stroke $l_{Hub} =$ [mm]	<b>Account the sign</b> (2)  (1) Direction of motion: left, right, up, down
Way of the motion sequence described above $l_{zyk.} =$ [mm]	
Total travel time $t_{zyk.} =$ [s]	
Max. velocity $v_{max} =$ [m/s]	
Other information:	

Operation time	Required lifetime
Cycles/hour [z/h] =	Cycles [z] $L_z =$
Working days/year [d/y] =	Kilometers [km] $L_{km} =$
	Years [y] $L_y =$

<b>Other notes</b>
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Linear Guideways



Ballscrews



Linear Motor Systems



Linear Axes with Ballscrews



Linear Actuators



Ball Bearings



Linear Motor  
Components



Rotary Tables



Drives

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