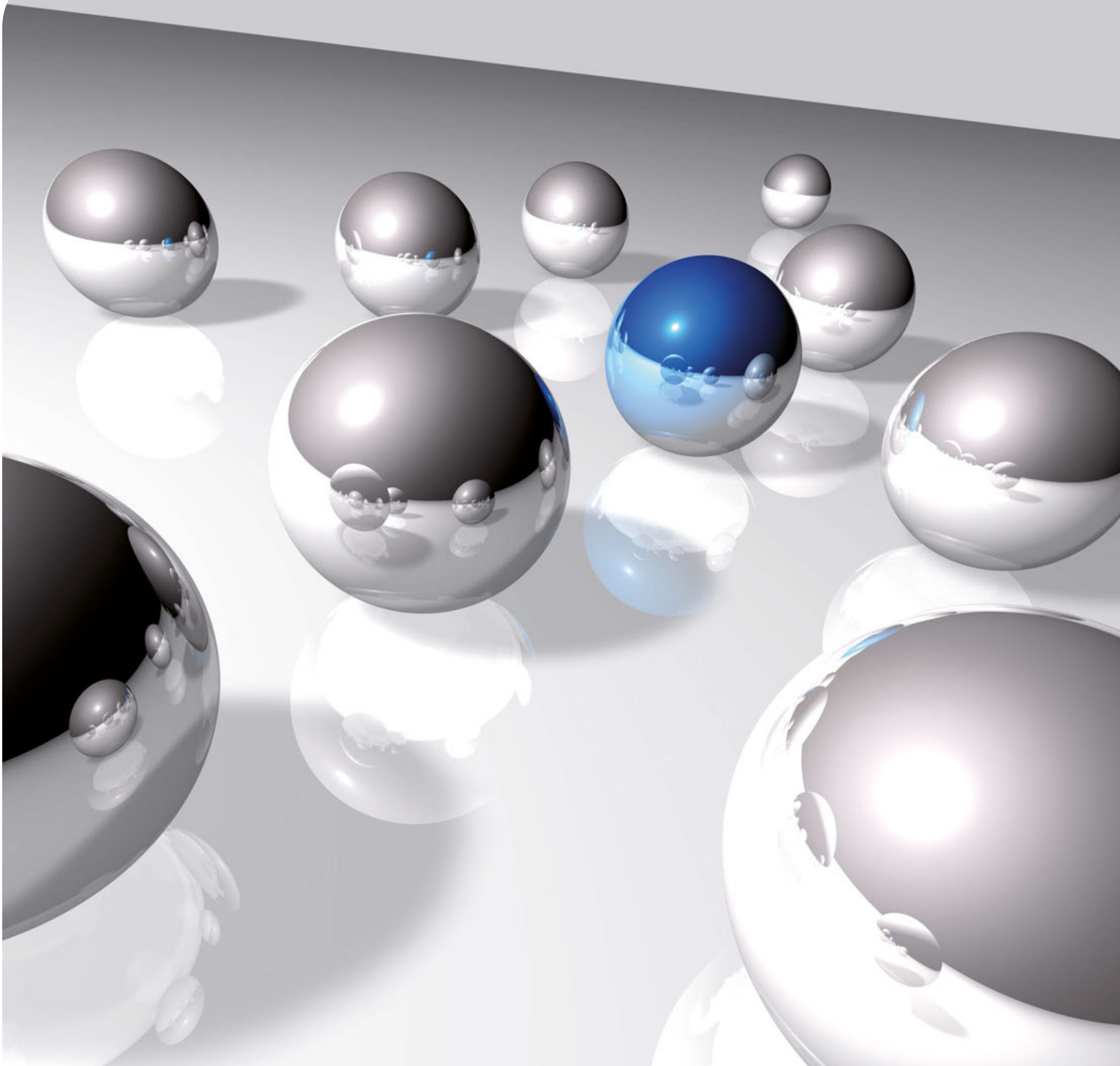


ROLLED BALL SCREWS –
THE ALTERNATIVE IN LINEAR TECHNOLOGY

INDEX

SCREW SHAFTS

Steinmeyer delivers the following product range of screw shafts on short notice. Those marked with * are available upon request.

The maximum available length of screw shafts is specified here. Different shaft lengths are available at additional cost.

The standard accuracy class for rolled screw shafts is T7. Tolerance classes T5, T9 and T10 are available upon request.

For information on ground ball screws please visit: www.steinmeyer.com

Diameter in mm	Lead 2 mm	Lead 2,5 mm	Lead 4 mm	Lead 5 mm	Lead 8 mm	Lead 10 mm	Lead 15 mm	Lead 20 mm	Lead 25 mm	Lead 32 mm	Lead 40 mm	Lead 50 mm
16	3 m*	3 m*	3 m*	3 m		3 m						
20	3 m*	3 m*	3 m*	3 m		3 m		3 m			3 m*	
25	6 m*			6 m		6 m		6 m	6 m			6 m*
32				6 m	6 m*	6 m	6 m*	6 m		6 m		
40				6 m	6 m*	6 m	6 m*	6 m			6 m	
50						6 m	6 m*	6 m				
63						6 m	6 m*	6 m				
80						6 m		6 m*				

>>> Pages 36 – 37

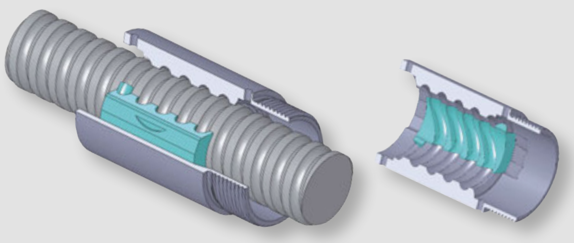
Maximum available total length in meters. Different shaft lengths available for extra charge. Standard accuracy class T7 (T5, T9, T10 upon request). Additional technical data on pages 36 – 37. Standard sizes available on short notice. *Special sizes upon request (delivery time).

NUTS ON MOUNTING SLEEVES

NUT WITH CONNECTING THREAD

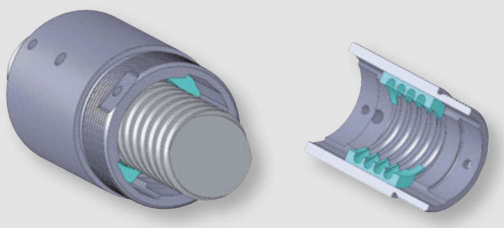
Cylindrical single nut with connecting thread, multiliner, wiper on both sides | >>> Pages 34 – 35

Order code	Diameter d_N [mm]	Lead P 5 [mm]	Lead P 10 [mm]
8132/5.16.3,5.4	16	•	
8132/5.20.3,5.4	20	•	
8132/5.25.3,5.5	25	•	
8132/5.32.3,5.5	32	•	
8132/10.32.6.4	32		•
8132/5.40.3,5.5	40	•	
8132/10.40.7,5.5	40		•
8132/10.50.7,5.6	50		•
8132/10.63.7,5.6	63		•
8132/10.80.7,5.6	80		•



Cylindrical single nut with connecting thread, multiliner, wiper on both sides, two thread-starts | >>> Pages 34 – 35

Order code	Diameter d_N [mm]	Lead P 5 [mm]	Lead P 10 [mm]
8142/10.25.3,5.4	25		•

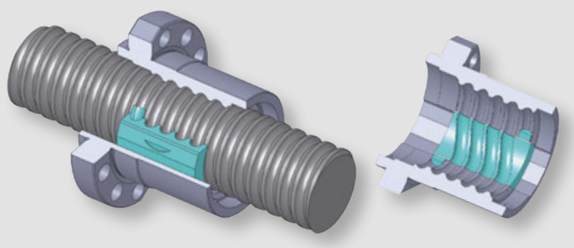


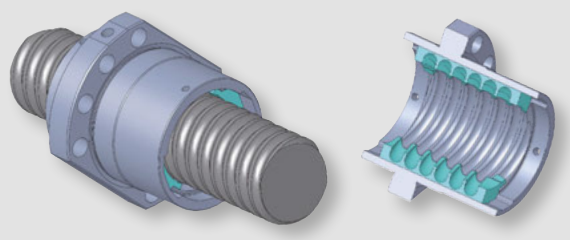
Continued on following pages >>>

NUTS ON MOUNTING SLEEVES

FLANGE NUT

Order code	Diameter d_N [mm]	Lead P 5 [mm]	Lead P 10 [mm]	Lead P 20 [mm]
Flange single nut, multiliner, wiper on both sides | >>> Pages 30 – 33				
8436/5.16.3,5.3	16	•		
8436/5.20.3,5.3	20	•		
8436/5.25.3,5.3	25	•		
8436/5.32.3,5.4	32	•		
8436/10.32.6.3	32		•	
8436/5.40.3,5.5	40	•		
8436/10.40.7,5.4	40		•	
8436/10.50.7,5.4	50		•	
8436/10.63.7.5.5	63		•	
8436/10.80.7,5.6	80		•	
Flange single nut, multiliner, wiper on both sides, two thread-starts | >>> Pages 30 – 33				
8446/20.50.7,5.6	50			•

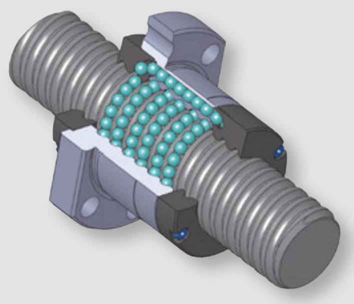


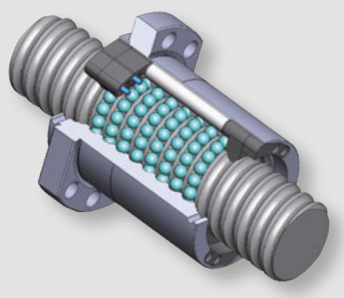


NUTS ON MOUNTING SLEEVES

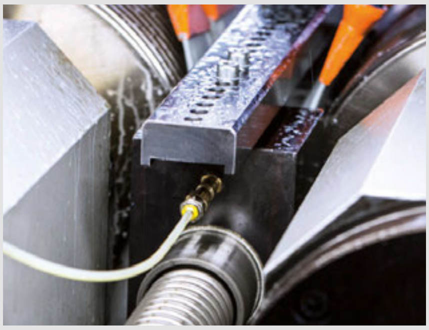
FLANGE NUT

Order code	Diameter d_N [mm]	Lead P 10 [mm]	Lead P 20 [mm]	Lead P 25 [mm]	Lead P 32 [mm]	Lead P 40 [mm]
Flange single nut, end cap return, wiper on both sides, two thread-starts | >>> Pages 30 – 33						
2446/10.16.3,5.6	16	•				
2446/10.20.3,5.6	20	•				
2446/20.20.3,5.4	20		•			
2446/10.25.3,5.6	25	•				
2446/20.25.3,5.4	25		•			
2446/25.25.3,5.4	25			•		
Flange single nut, external through-the-nut return , wiper on both sides, two thread-starts | >>> Pages 30 – 33						
3446/20.32.6.4	32		•			
3446/32.32.6.2	32				•	
3446/20.40.6.6	40		•			
3446/40.40.7,5.4	40					•
3446/20.63.7,5.6	63		•			

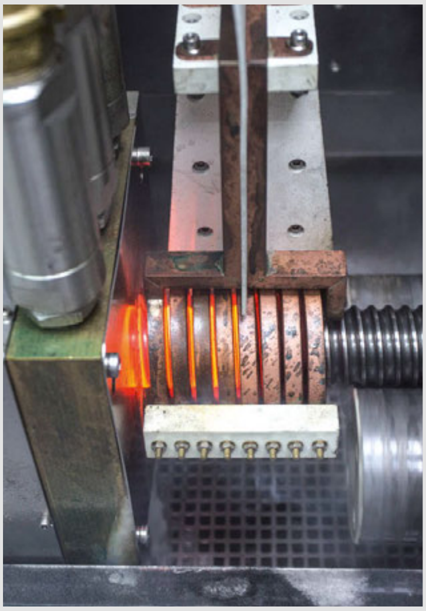




2.1 | MANUFACTURING PROCESS

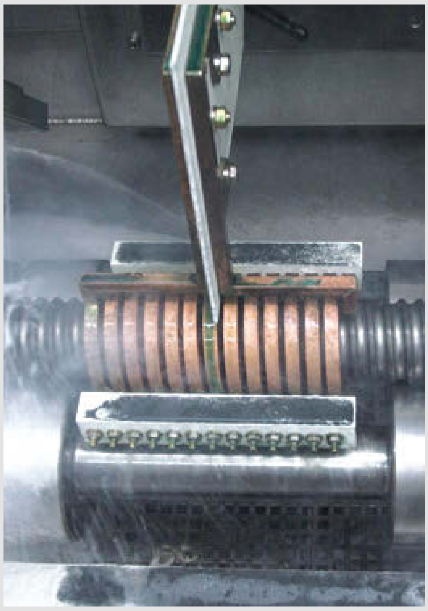


Thread rolling



Heat treatment: annealing ...

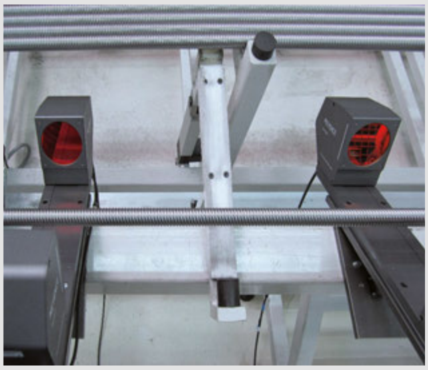
Quenching ...



and tempering

Alignment

Polishing



Measuring

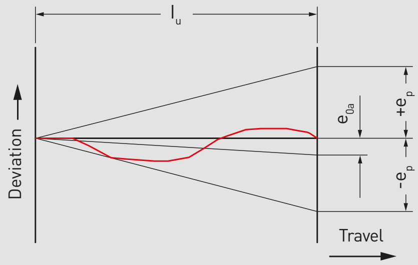
2.2 | ACCURACY CLASSES

Steinmeyer classifies rolled ball screws according to ISO 3408 part 3 – as transport ball screws in tolerance class T5 through T10.

2.2.1 | Lead error

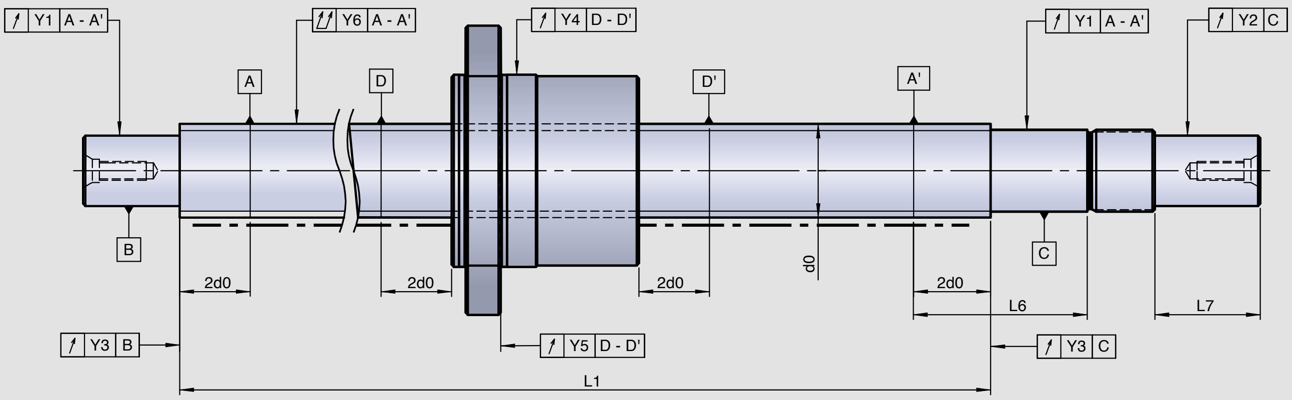
Limit e_p for the average lead error e_{0a} [µm]

l_u [mm]	Tolerance classes T5	T7	T9	T10
200 – 315	23	52	130	210
315 – 400	31	69	173	280
400 – 500	38	87	217	350
500 – 630	48	109	273	441
630 – 800	61	139	347	560
800 – 1.000	77	173	433	700
1.000 – 1.250	96	217	542	875
1.250 – 1.600	123	277	693	1120
1.600 – 2.000	153	347	867	1400
2.000 – 2.500	192	433	1083	1750
2.500 – 3.150	242	546	1365	2205
3.150 – 4.000	307	693	1733	2800
4.000 – 5.000	383	867	2167	3500
5.000 – 6.300	483	1092	2730	4410



2.2.2 | Shape and position tolerances

The following values define the shape and position tolerances of the functional surfaces of the ball screws. They are specifically applicable when no other specifications are provided. Measurement using Vee-block supports at the outside diameter of the shaft at points A and A' and D and D'.



Bearing journal concentric run-out Y1 [µm]

Nominal-ø [mm]	L [mm]	T5	T7	T9	T10
16 - 20	80	20	40	63	63
25 - 50	125	25	50	80	80
63 - 80	200	32	63	100	100

*Measurement E 6.1 according to ISO 3408 for journal length L6 ≦ L. The following applies for L6 > L: tolerance value *L6/L*

Drive journal concentric run-out Y2 [µm]

Nominal-ø [mm]	L [mm]	T5	T7	T9	T10
16 - 20	80	8	12	16	16
25 - 50	125	10	16	20	20
63 - 80	200	12	20	25	25

*Measurement E 6.1 according to ISO 3408 for pin length L7 ≦ L. The following applies for L7 > L: tolerance value *L7/L*

Bearing journal axial run-out Y3 [µm]

Nominal-ø [mm]	T5	T7	T9	T10
16 - 63	5	6	10	10
80	6	5	12	12

The values specified have been converted and correspond with the specifications of ISO 3408.

Nut concentric run-out Y4 [µm]

Nominal-ø [mm]	T5	T7	T9	T10
16	16	20	-	-
20 - 40	20	25	-	-
50 - 80	25	32	-	-

The values specified have been converted and correspond with the specifications of ISO 3408.

Concentric run-out of nut flange and shaft OD Y5 [µm]

Nominal-ø [mm]	T5	T7	T9	T10
16 - 25	20	25	-	-
32 - 63	25	32	-	-
80	32	40	-	-

The values specified have been converted and correspond with the specifications of ISO 3408.

Concentric run-out of shaft exterior diameter Y6 for short shafts [µm]

Nominal-ø [mm]	Length of thread L1 [mm]	Measuring interval [mm]	T5	T7	T9	T10
16 - 25	< 640	160	32	40	80	80
32 - 50	< 1260	315	32	40	80	80
63 - 80	< 2520	630	32	40	80	80

The measuring interval should be chosen according to the chart.
(Thread length ≦ 4 Measuring interval)*

Concentric run-out of shaft exterior diameter Y6 for long shafts [µm]

Nominal-ø [mm]	Length of thread L1 [mm]	Measuring interval [mm]	T5	T7	T9	T10
16 - 25	> 640	160	64	80	160	160
32 - 50	> 1260	315	64	80	160	160
63 - 80	> 2520	630	64	80	160	160

The measuring interval should be chosen according to the chart.
(Thread length > 4 Measuring interval)*

2.3 | BEARING JOURNALS AND BEARING RECOMMENDATIONS

The mounting should allow for rotation of the shaft and simultaneously pass the axial force on the ball screw into the adjacent construction with as little deformation as possible. Modern ball screw drives have very high load bearing capacity and stiffness, such that only high-quality bearings that are optimized for drive screw mounting can adequately meet requirements. An attachment to the shaft that is adequate for the axial and prestressing force of this bearing is of crucial importance.

Fig. 1

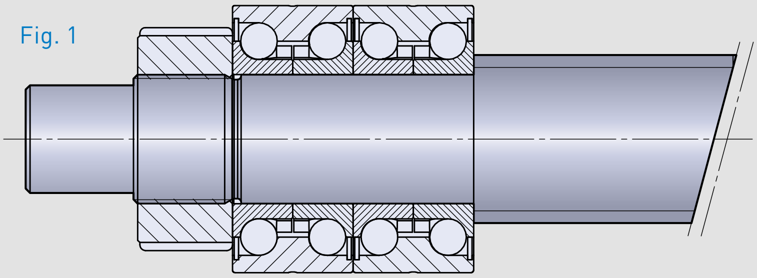


Fig. 1: The most simple and cost-effective option consists of a bearing journal that is sufficiently small compared to the nominal diameter of the shaft. Ideally, the shoulder surface underneath the minor diameter of the shaft can sufficiently absorb the force without deformation.

Fig. 2

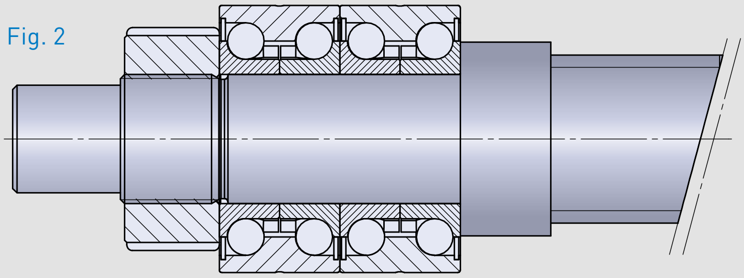


Fig. 2: If the full shoulder is not sufficient, a shrunk-on ring with an exterior diameter larger than the shaft diameter is necessary.

2.3.1 | Bearing selection

The support bearing of a ball screw should be able to absorb the axial force produced by the nut and the lateral forces from the belt drive. It can sometimes be difficult to find a suitable bearing for ball screws with large cycle criteria, and high load rating. At the same time, the bearing should have a sufficiently small inner ring bore hole and a supporting diameter no larger than the shaft nominal diameter.

This discussion thus only represents an initial point of reference for selection of bearings. It is by no means meant to be universally applicable or complete. The following criteria apply to the selection of a bearing:

- Axial dynamic load rating roughly equivalent to the dynamic load rating of the ball nut.
- Support shoulder for the bearing inner ring no larger than the minor diameter of the shaft for journal version fig. 1 (see page 13).
- The bearing should also be compatible with the same lubrication method (oil/grease) and the same speed as the ball screw.

.

2.3.2 | Commonly used bearings

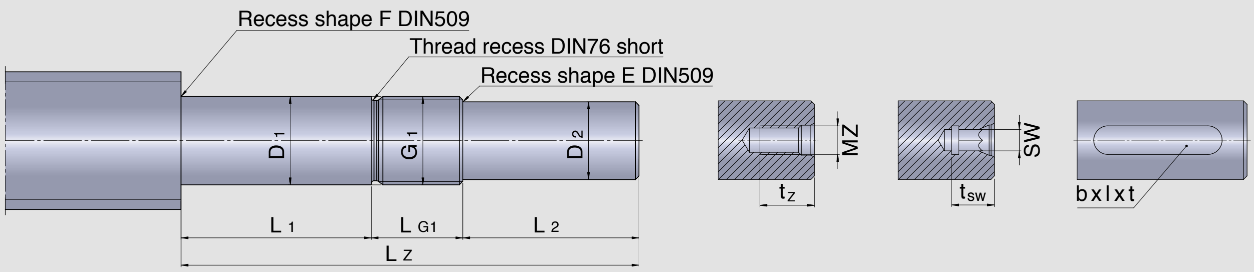
Steinmeyer recommends installing INA (angular) ball bearings. The following chart is an overview of commonly used bearings. Since it is not possible to display all combinations here, we ask that you consult with us for your special applications.

Ball screw drive Nominal-ø [mm]	INA mounting selection for fixed bearings	
	According to chapter 2.3 (page 13) fig. 1 (complimentary to standard machining A described in chapter 2.3.3)	According to chapter 2.3 (page 13) Fig. 2
16	ZKLN1034	ZKLN1242
20	ZKLN1242	ZKLN1545
25	ZKLN1747	ZKLN2052
32 (P=5)	ZKLN2557	-
32 (P≧10)	ZKLN2052	ZKLN2557-2AP
40 (P=5)	ZKLN3062	-
40 (P≧10)	ZKLN2557-2AP	ZKLN3062-2AP
50	ZKLN3572-2AP	ZKLN4075-2AP
63	ZKLN4075-2AP	ZKLN5090-2AP
80	ZARN5090-TV	ZARN50110-TV

Ball screw drive Nominal-ø [mm]	Bearing selection for loose bearings	
	Loose bearing (complimentary to standard machining B described in chapter 2.3.3)	Locking ring According to DIN 471
16	6200	10x1
20	6201	12x1
25	6203	17x1
32 (P=5)	6204	20x1,2
32 (P≧10)	6204	20x1,2
40 (P=5)	6206	30x1,5
40 (P≧10)	6206	30x1,5
50	6207	35x1,5
63	6210	50x1,5
80	6212	60x2

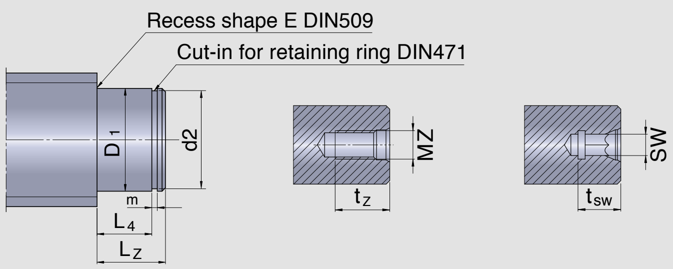
2.3.3 Bearing journals - standard machining

Shaft ends are machined as specified in the drawing. Enter the letter »Z« into the order reference and include the corresponding drawing. You will also be able to choose between the following fixed and loose bearing configurations.



Fixed bearing journals: A | Machining options: K – hexagonal socket, G – internal thread, N – keyway groove

Size		Dimensions (mm)							Center hole incl. internal thread		Hexa-gonal socket		Keyway groove according to DIN6885 (centrally positioned in drive journal)		
d_0	P	L_z	D_1h6	L_1	D_2h7	L_2	G_1	LG_1	MZ	t_z	SW	t_{SW}	b P9	l	t
16	5/10	50	10	18	8	20	M10x1	12			4	5			
20	5/10/20	60	12	23	10	25	M12x1	12			4	5	3	20	1.8
25	5/10/20/25	75	17	23	15	30	M17x1	22	M5	12	4	5	5	25	3.0
32	10/20/32	78	20	26	16	35	M20x1	17	M5	12	4	5	5	28	3.0
32	5	80	25	25	22	40	M25x1.5	15	M5	12	4	5	5	28	3.0
40	10/20/40	130	25	54	22	50	M25x1.5	26	M8	19	6	8	6	36	3.5
40	5	101	30	25	25	50	M30x1.5	26	M10	22	8	10	8	36	4.0
50	10/20	144	35	66	30	50	M35x1.5	28	M10	22	10	12	8	36	4.0
63	10/20	154	40	66	36	60	M40x1.5	28	M12	28	12	12	10	40	5.0
80	10	160	50	58	40	70	M50x1.5	32	M16	36	12	12	12	50	5.0



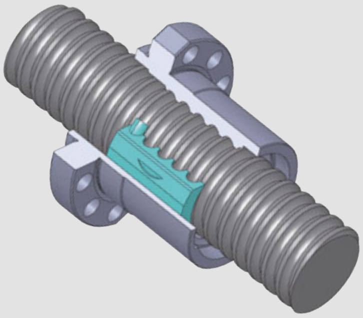
Loose bearing journals: B | Machining options: K - hexagonal socket, G – internal thread

Size		Dimensions (mm)						Center hole incl. internal thread		Hexa-gonal socket	
d_0	P	D_1 h6	L_z	L_4	d_2	d_2 Tolerance	m H13	MZ	t_z	SW	t_{SW}
16	5/10	10	12	9	9.6	h10	1.10			4	5
20	5/10/20	12	13	10	11.5	h11	1.10	M4	10	4	5
25	5/10/20/25	17	15	12	16.2	h11	1.10	M6	16	5	5
32	5/10/20/32	20	18	14	19.0	h11	1.30	M6	16	5	5
40	5/10/20/40	30	20	16	28.6	h12	1.60	M10	22	10	10
50	10/20	35	22	17	33.0	h12	1.60	M12	28	12	12
63	10/20	50	27	20	47.0	h12	2.15	M16	36	17	12
80	10	60	29	22	57.0	h12	2.15	M20	42	17	12

2.4 | BALL RETURN

As the world's only manufacturer never to use tubes, Steinmeyer uses all commonly known other designs for ball returns. However, the multiliner return represents the standard for all rolled ball screws. Steinmeyer also uses external return either as through-the-nut or end cap return.

2.4.1 | Multiliner (internal return)



Multiliners lift the balls out of the track and guide them over the outer diameter of the shaft into the next available track.

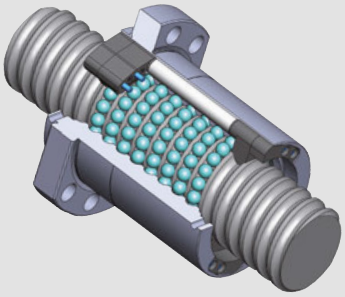
This type of internal return is particularly compact and yields the smallest nut diameters of any ball return system.

It is also the ball return of choice for very small ball sizes and small leads.

2.4.2 | Technical tip:

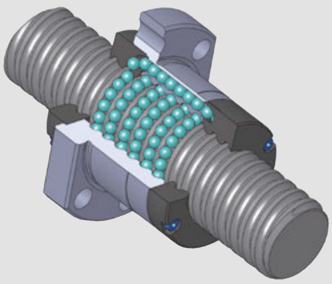
Ball nuts require a means to recirculate balls. Without it, the ball circuit would not be closed and balls would fall out at the rear end of the nut.
Design of the ball return is the determining factor for the maximum speed at which the ball nut can safely operate. This is normally expressed by the DN value. The better the ball return system deals with mass forces of the balls, the higher the DN value. Manufacturers typically quote DN values from 60.000 for basic tube returns to 160.000 and higher, e.g. the UltraSpeed return from Steinmeyer.

2.4.3 | Through the nut return (external return)



Steinmeyer's UltraSpeed return is normally used for lead/diameter ratios greater than 0.5. It is normally used with dual start threads. Balls are lifted off the shaft using a deflector at one end of the nut and then guided through a bore (internal to the nut body) to the other end of the nut, where a similar piece guides the balls back onto the thread. One pair of deflectors serves one circuit (i.e. one of the threads), which includes several turns.

2.4.4 | End cap return (external return)



End cap return works very much like the previously described through-the-nut return, with the exception that the ball deflector function is executed using a cap that is integrated onto the front of the nut along with the wiper. End cap return is normally used for very large lead/diameter ratios.

2.5 | ROTATION SPEED VALUES

2.5.1 | Critical speed

Critical speed is the first (lowest) speed at which the ball screw shaft is in resonance. In applications with rotating shafts it limits the rpm of the screw. Variables that influence it are shaft diameter, unsupported length and support bearing configuration.

Detailed calculations can be performed upon request.

2.5.2 | Maximum speed

A second limitation is imposed by the mass forces upon balls. It depends on internal construction of the ball nut and in particular the ball return, and ball diameter (or mass).

2.5.3 | DN Value

DN values allow easy comparison between different ball screw designs. More sophisticated ball return systems result in higher DN values and, conversely, lower DN values are associated with less sophisticated ball return methods. DN values provide direct correlation to ball velocity.

$$DN = n_{max} \cdot d_N$$

n_{max} = Maximum speed [rpm]
d_N = Nominal diameter [mm]
DN = Rotation speed value

The ball screw drives available today have possible DN values of up to 160,000. However, Steinmeyer recommends observing the maximum speeds published here for each size. Use the following values for orientation purposes and of course for Steinmeyer ball screws only.

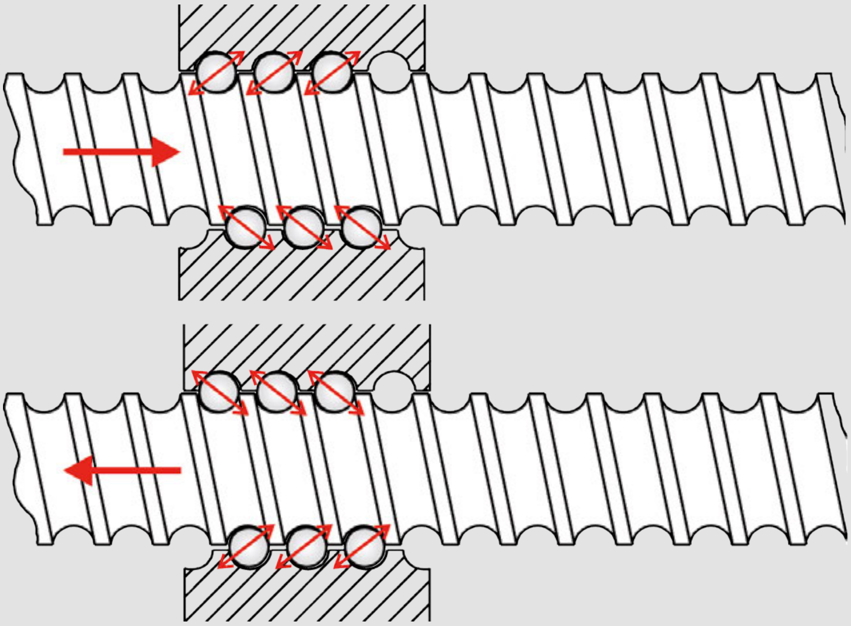
- Internal return (Series 8xxx): DN ≦ 80.000
- External return (UltraSpeed and end-cap return) (Series 2xxx und 3xxx): DN ≦ 160.000

2.6 | NUT CLEARANCE

Single nut with backlash

Steinmeyer produces rolled ball screws with a single nut with clearance. This axial clearance amounts to approx. 0.01 mm with a maximum 0.06 mm for the sizes displayed here.

Versions that are free of clearance/ pre-tensioned are available upon request. In this instance the nut is not available separately, but is supplied already mounted to the screw shaft.



- Axial clearance (approx. 0.01 – 0.06 mm)
- Contact point change with changes in load direction
- always two-point contact
- Balls carry load alternately in both directions

2.7 | MAXIMUM LOADS

The average axial load of a ball screw is normally around 10 % of the dynamic load rating C_a. A load of exactly 10 % of C_a would lead to a calculated fatigue life of 10^9 revolutions. This is the upper limit of the scope of application of the service life calculation. The applied mean load can be somewhat higher, but normally not more than 20 % of C_a.

Not all ball screw nuts can be loaded up to the static load rating. For specifications with high dynamic load ratings (which might have to be selected due to the desired fatigue life), the static load rating is necessarily very high. The flange, nut body and attaching screws can break before this load has been reached. Here are the maximum axial forces that can be employed safely.

Attention: the maximum axial load is always the smaller value from the static load rating C_{0a} (avoiding track indentations) and the value given here (for avoiding damages). The necessary condition is the optimum distribution of compressive force to the flange and flush installation with centric force application.

Values to avoid damage – Flanged Nuts

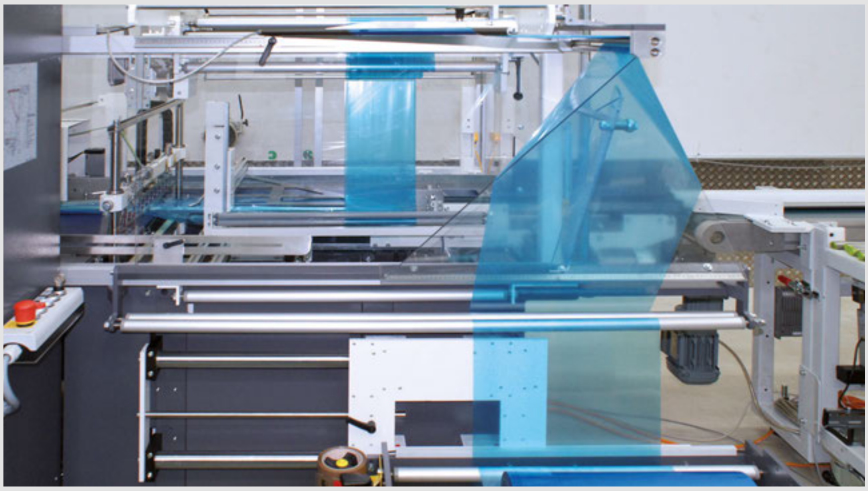
Nominal-ø [mm]	DIN 69051 screws	Clamping torque [Nm]*	Nut max. allowable axial force [kN]
16	6xM5	6	12
20	6xM6	10	16
25	6xM6	10	16
32	6xM8	25	32
40	8xM8	25	40
50	8xM10	49	80
63	8xM10	49	80
80	8xM12	86	125

**Socket head cap screws DIN ISO 4762, strength category 8.8 (90 % utilization, safety factor 0.8, friction μ = 0.14)*

Values to avoid damage - Nuts with connecting thread

Nominal -ø [mm]	Lead [mm]	Connection thread	Tightening torque [Nm]	Nut max. allowable axial force [kN]
16	5	M30x1.5	40	19
20	5	M35x1.5	60	25
25	5	M40x1.5	100	36
25	10	M40x1.5	100	36
32	5	M48x1.5	120	36
32	10	M48x1.5	150	45
40	5	M56x1.5	200	51
40	10	M60x2	250	59
50	10	M72x2	300	59
63	10	M85x2	350	58
80	10	M110x2	400	51

Additional securing is mandatory for nominal diameter ≧ 50 mm (values in blue).
For all other nuts, additional securing is recommended (e.g. with adhesive Loctite 243 or a mechanical safety)!



Fully automated packing divice

2.8 | WIPERS

Plastic wiper

Segment wipers are standard in a variety of applications: they reliably prevent the penetration of shavings and coarse dirt particles but allow for a certain amount of lubricant leakage. In conjunction with an automatic oil and/or grease system, a rinsing effect of the nut occurs, resulting in a high level of operational safety.

2.9 | LUBRICATION, INSTALLATION AND ASSEMBLY

2.9.1 | Handling

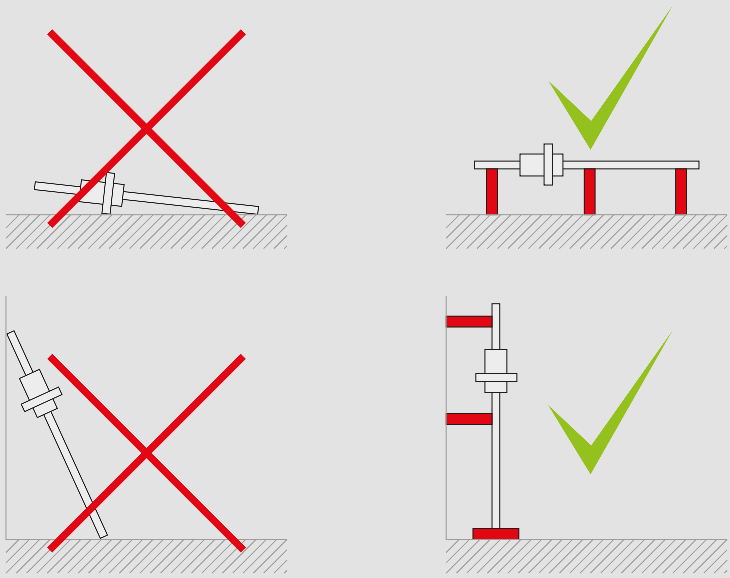
Ball screws should be protected against damage and dirt particles. No additional treatment of the ball screws is necessary after delivery and they can be immediately stored. They should be kept in the protective covering until installation.

2.9.2 | Storage

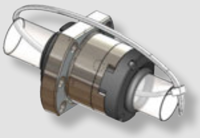
Heavy units should not be placed on the nut. Placing supports underneath can prevent bending of the shaft. Temperature fluctuations should be avoided in the storage space (risk of build up of condensation).

2.9.3 | Cleaning

- Petrol or kerosene can be used for cleaning. This should be thinly applied to the shaft and then thoroughly removed with dry compressed air.
- Periodic movement of the nut results in improved cleanliness.
- Use a lint-free rag for cleaning

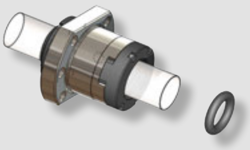


2.9.4 | Nut assembly



Before the nut can be mounted on the shaft, the following points should be reviewed:

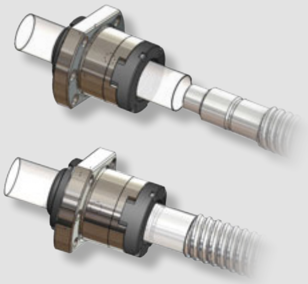
- Has the shaft been cleaned and aligned?
- Is the thread burr-free?
- Check desired nut orientation on the shaft (e.g. flange to the short journal side?)
- Align nut mounting tube on the shaft accordingly



Remove safety device

During transport, the nut is secured using cable tie or o ring. This must be removed before installation.

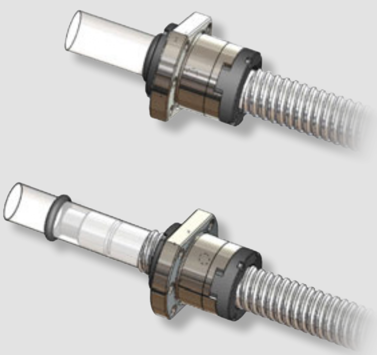
Attention: It is important to ensure that the nut does not slide down the tube as the balls can be lost.



Positioning the tube at the top of the thread

Depending on the orientation, the tube (with nut) will either be positioned on the long or short journal end of the shaft.

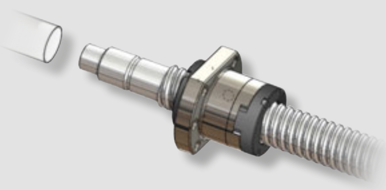
Attention: It is important to ensure that it rests flush with the thread.



Installing the nut onto the shaft

The nut is now carefully pushed forward on the tube until the front edge of the nut is right next to the shaft thread. Now the nut is carefully rotated onto the shaft. There should be only minimal resistance. The following guideline value applies: **Threading force in [N] = 1/2-nominal-Ø [mm]** (Threading force is the force required for the area of the nut).

The nut is then completely installed onto the shaft. NB: if the wiper begins to dislodge stop, back off, and then try again holding the wiper in place with your thumb as you rotate the nut onto the shaft.



Removing the mounting sleeve

The mounting tube may only be removed if it is ensured that the nut is entirely on the shaft, complete with balls and wipers.

Removing the nut from the shaft

In order to remove the nut from the shaft, repeat the above process in reverse order, using a mounting tube.

2.9.5 | Installation

Because the lifespan of the ball screw depends upon exact assembly, the following points must be observed:

- Maximum cleanliness should be observed. The ball screw should not be removed from the package until right before installation. If necessary, clean and apply corrosion protection (either grease or oil) to the shaft before assembly.
- In order to avoid hitting the slide, the stroke limiter switch should be installed and activated as soon as possible.
- The shaft must be accurately aligned with the guide tracks of the machine parts to be moved.

Important: Do not unscrew the nut beyond the thread of the shaft. (If this happens, the complete ball screw assembly should be returned for inspection.)

Steinmeyer recommends that the installation of the ball screw adhere to the positional tolerance guidelines specified here (fig. 1). Optimal parallelism between the guide channel and the ball screw drive axle, as well as perpendicularity of the nut attachment ensure that the drive unit is not warped, thus achieving a longer life. After the installation, ensure that the ball screw drive can be freely moved in all positions (depending on pre-stressing).

If the nut is at the outermost point on the shaft or as close as possible to the fixed bearing, possible warping will be easiest to identify.

Any misalignment can lead to premature failure of the ball screw.

Fig. 1: Misalignment (shaft parallel to guideway)

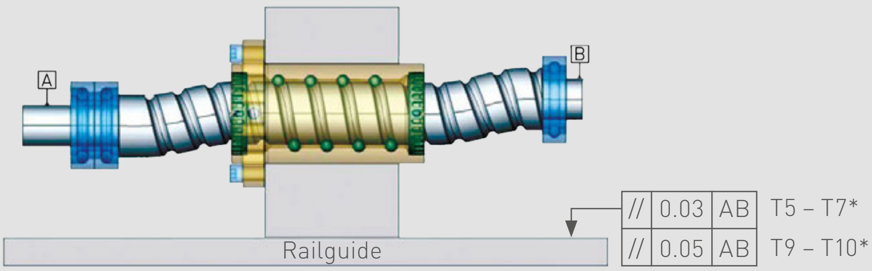
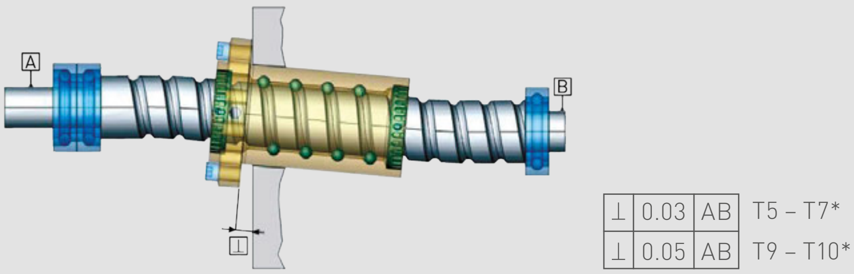


Fig. 2: Tilt error (perpendicularity) surface for attaching the ball nut to the structure



*T5-T7 = Lead accuracy ISO 3408 for nuts with little or no clearance

*T9-T10 = Lead accuracy ISO 3408 suitable for nuts with clearance

2.9.6 | Lubrication

A grease gun is necessary. The grease should be as similar as possible to the grease used for the initial greasing (see table 1). If this is not possible, the minimum requirements for mixing different kinds of grease must be met:

- The same or compatible soap base
- Base oil of the same kind of oil with comparable viscosity

The re-lubrication intervals should be adhered to. Apply the following for a nut with plastic segment wipers: re-lubricate at least 4 times per year or every 500 operating hours. Remove any dirt on the shaft or the nut with a lint-free rag before re-lubricating.

Lubricate with the specified amount of grease (see table 2) through the lubrication hole.

Note: grease should be evenly distributed during re-lubrication. This can be accomplished by moving the nut while re-lubricating. It should be noted that increased frictional torque and hence increased temperature can be expected during operation directly after re-lubrication. Frequent re-lubrication with relatively little grease is better than occasional re-lubrication with a lot of grease.

Table 1: Grease used

Kübler	Lubcon	Application
Staburags NBU 8 EP	Turmogrease PHS 1002	Standard grease
Staburags NBU 12/300KP	Turmogrease CAK 4002	Grease for long-term lubrication
Isoflex LDS 18 Spezial A	Thermoplex 2 TML Spezial	Smooth running grease
Klüberalpha BHR 53-402	Turmotemp Super 2 EP	High temperature grease
Isoflex PDL 300 A	Thermoplex TTF 122	Low temperature grease
Klübersynth UH1 14-151	Turmosynthgrease ALN 2501	Food grade grease

Table 2: Amount of grease

Nominal-Ø [mm]	Amount of grease [g]	Nominal-Ø [mm]	Amount of grease [g]
16	0.2	40	4
20	0.3	50	6
25	0.4	63	12
32	1.4	80	15

3.1 | ORDER CODE

Order code (Example) **8 4 3 6 / 5 . 25 . 410 . 500 . T7 . V0 . A . KN . B . G . x**

0	No nut (screw shaft only)
2	Nut with end cap return
3	Nut with through-the-nut return
8	Nut with multiliner
0	No nut (screw shaft only)
1	Nut with connecting thread
4	Single flange nut
3	Rolled thread– one start
4	Rolled thread – two or more starts
5	Screw shafts without nut
4	Nut dimensions special version
6	Flange nut dimensions according to ISO 3408
2	Dimensions according to Steinmeyer standards (for nuts with connecting thread)
...	Lead
...	Diameter (nominal)
...	Ball diameter (for nuts on sleeve)
...	Number of circuits (for nuts on sleeve)
...	Thread length (different for screw shafts with journal machining)
...	Total length (screw shafts)
T	Transportation ball-screw
...	Tolerance class according to ISO 3408 (standard 7, classes 5, 9, 10 upon request)
V –	Nut with axial clearance (mounted or single nuts on mounting sleeve)
V0	Nut mounted free of clearance (approx. 0-2 % of Ca)
V5	Nut mounted pre-stressed (approx. 5 % of Ca)
Z	Bearing journals machined according to drawing
-	Without fixed bearing journal, cut and chamfered
A	Fixed bearing journal, machined according to catalogue standard
K	Hexagonal socket
G	Center hole incl. internal thread
N	Keyway groove
-	Without machining options
-	Without loose bearing journal, cut and chamfered
B	Loose bearing journal, machined according to catalogue standard
K	Hexagonal socket
G	Center hole incl. internal thread
-	Without machining options
	Mounting direction of nut flange or nut connecting thread (Option for mounted nut incl. final processing)
x	For long-machined journal
y	For short-machined journal

Example for ball screw drive with machined journals: **8436/5.25.410.500.T7.V0.A.KN.B.G.x**

Example for nut on mounting sleeve: **8436/5.25.3,5.3**

Example for shaft only: **0035/5.25.6000.6000 T7**

3.2 | AVAILABILITY

- Shafts and nuts with standard dimensions shown here are available on short notice.
- Additional sizes, ball screws assembled according to drawing, including machined journals with assembled nuts are available upon request.
- Special dimensions not listed here, as well as corrosion-resistant ball screws, are also available upon request.
- Special industry-specific solutions are available, such as for the woodworking industry, with ground shaft outer diameter and special wipers.

>>> Let us know.

Storing and logistics for ball screw shafts

4.1 | FLANGE NUTS ON MOUNTING SLEEVES

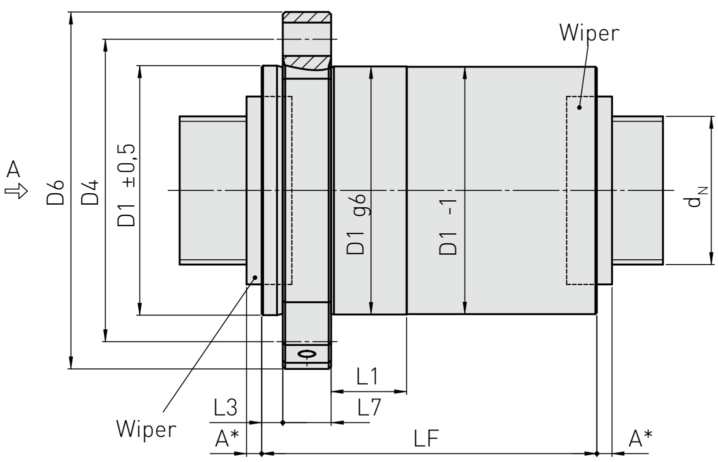
Model series 2446 | Flange single nut with end cap return, wiper on both sides, two or more threadstarts.

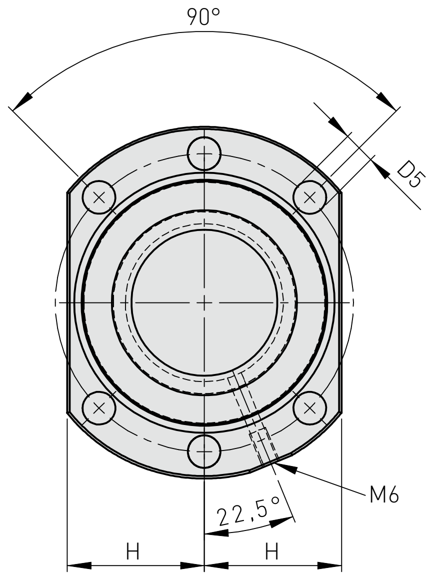
Model series 3446 | Flange single nut with external high-speed through-the-nut return, wiper on both sides, two or more threadstarts.

Model series 8436 | Flange single nut with multiliner, wiper on both sides.

Type	Lead P [mm]	Nominal diameter d_N [mm]	Ball diameter d_W [mm]	Number of circuits [i]	Dynamic load capacity C_a [kN]	Static load capacity C_{0a} [kN]
8436/5.16.3,5.3	5	16	3.5	3	10.1	12
2446/10.16.3,5.6	10	16	3.5	3 + 3	19.6	27.4
8436/5.20.3,5.3	5	20	3.5	3	12.1	16.7
2446/10.20.3,5.6	10	20	3.5	3 + 3	22.8	36.5
2446/20.20.3,5.4	20	20	3.5	2 + 2	14.7	22.4
8436/5.25.3,5.3	5	25	3.5	3	13.7	21.5
2446/10.25.3,5.6	10	25	3.5	3 + 3	25.2	45.4
2446/20.25.3,5.4	20	25	3.5	2 + 2	17.1	29.5
2446/25.25.3,5.4	25	25	3.5	2 + 2	16.7	29
8436/5.32.3,5.4	5	32	3.5	4	20.4	39.8
8436/10.32.6.3	10	32	6	3	30.8	45.6
3446/20.32.6.4	20	32	6	2 + 2	39.3	63.6
3446/32.32.6.2	32	32	6	1 + 1	18.2	26.5

The load ratings listed here apply to accuracy class T5.
Use factor 0.9 for T7 and factor 0.7 for T10 in order to reduce load ratings.





Hole pattern 1

Hole pattern 1, flange form B according to ISO 3408.

Hole pattern	LF [mm]	ø D1 g6 [mm]	L1 [mm]	ø D4 [mm]	ø D5 [mm]	ø D6 [mm]	L7 [mm]	L3 [mm]	H [mm]
1	46	28	10	38	5.5	48	10	6	20
1	44	32	16	42	5.5	52	10	12	20
1	46	36	10	47	6.6	58	10	6	22
1	49	36	10	47	6.6	58	10	7	22
1	57	36	10	47	6.6	58	10	7	22
1	46	40	10	51	6.6	62	10	6	24
1	49	40	16	51	6.6	62	10	7	24
1	57	40	16	51	6.6	62	10	7	24
1	66	40	16	51	6.6	62	10	7	24
1	53	50	10	65	9	80	12	6	31
1	72	50	16	65	9	80	12	7	31
1	68	56	20	71	9	86	14	7	32.5
1	60 + 2x5*	56	20	71	9	86	14	7 + 5*	32.5

* Wiper overlap

Continued on following page >>>

4.1 | FLANGE NUTS ON MOUNTING SLEEVE

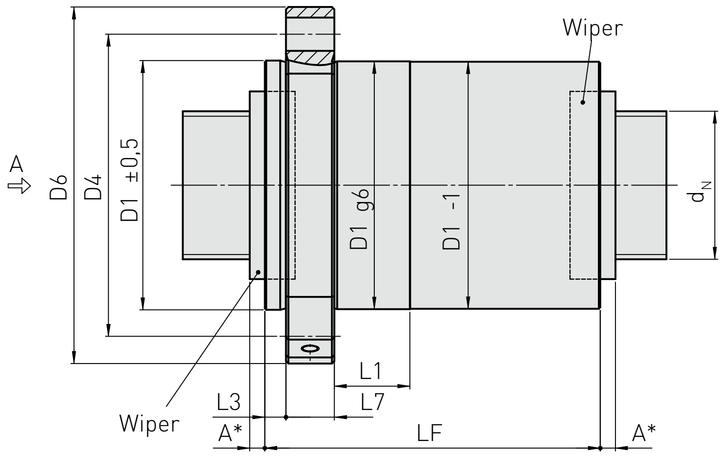
Model series 3446 | Flange single nut with external high-speed through-the-nut return, wiper on both sides, two or more threadstarts.

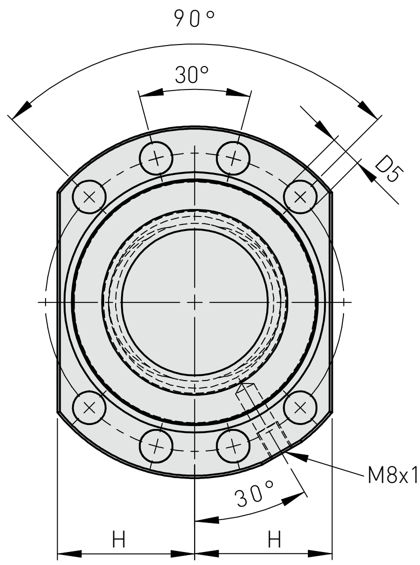
Model series 8436 | Flange single nut with multiliner, wiper on both sides.

Model series 8446 | Flange single nut with multiliner, wiper on both sides, two or more threadstarts.

Type	Lead P [mm]	Nominal diameter d_N [mm]	Ball diameter d_w [mm]	Number of circuits [i]	Dynamic load capacity C_a [kN]	Static load capacity C_{0a} [kN]
8436/5.40.3,5.5	5	40	3.5	5	27.5	63.6
8436/10.40.7,5.4	10	40	7.5	4	59	95.1
3446/20.40.6.6	20	40	6	3 + 3	64.9	126.3
3446/40.40.7,5.4	40	40	7.5	2 + 2	59	96.6
8436/10.50.7,5.4	10	50	7.5	4	67.4	124.3
8446/20.50.7,5.6	20	50	7.5	3 + 3	84	154.4
8436/10.63.7,5.5	10	63	7.5	5	91.8	201.1
3446/20.63.7,5.6	20	63	7.5	3 + 3	107.6	249.1
8436/10.80.7,5.6	10	80	7.5	6	123.8	328.6

The load ratings listed here apply to accuracy class T5.
Use factor 0.9 for T7 and factor 0.7 for T10 in order to reduce load ratings.





Hole pattern 2

Hole pattern 2, flange form B according to ISO 3408.

Hole pattern	LF [mm]	Ø D1 g6 [mm]	L1 [mm]	Ø D4 [mm]	Ø D5 [mm]	Ø D6 [mm]	L7 [mm]	L3 [mm]	H [mm]
2	60	63	10	78	9	93	14	6	35
2	84	63	16	78	9	93	14	7	35
2	89	63	20	78	9	93	14	19.5	35
2	107	70	25	85	9	100	14	21	37.5
2	86	75	16	93	11	110	16	7	42.5
2	90	75	16	93	11	110	16	22	42.5
2	98	90	16	108	11	125	18	7	47.5
2	91	95	25	115	13.5	135	20	24	50
2	110	105	16	125	13.5	145	20	7	55

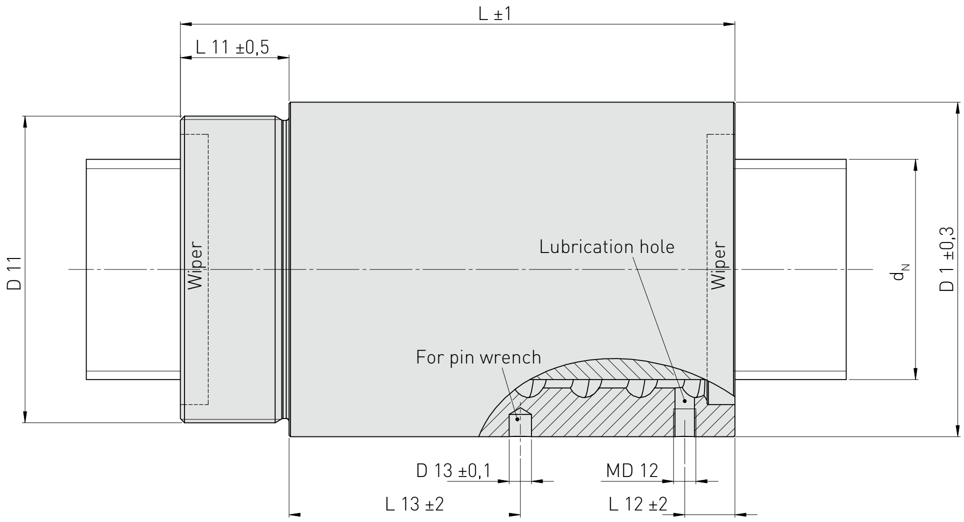
4.2 | NUTS WITH CONNECTING THREAD ON MOUNTING SLEEVE

Model series 8132 | Nut with connecting thread with multiliner, wiper on both sides.

Model series 8142 | Nut with connecting thread with multiliner, wiper on both sides, two or more threadstarts.

Type	Lead P [mm]	Nominal diameter d_N [mm]	Ball diameter d_W [mm]	Number of circuits [i]	Dynamic load capacity C_a [kN]	Static load capacity C_{0a} [kN]
8132/5.16.3,5.4	5	16	3.5	4	12.9	16
8132/5.20.3,5.4	5	20	3.5	4	15.5	22.3
8132/5.25.3,5.5	5	25	3.5	5	21.2	35.9
8142/10.25.3,5.4	10	25	3.5	2 + 2	16.1	25.5
8132/5.32.3,5.5	5	32	3.5	5	24.8	49.7
8132/10.32.6.4	10	32	6	4	39.4	60.8
8132/5.40.3,5.5	5	40	3.5	5	27.5	63.6
8132/10.40.7,5.5	10	40	7.5	5	71.5	118.9
8132/10.50.7,5.6	10	50	7.5	6	95.6	186.5
8132/10.63.7,5.6	10	63	7.5	6	107.4	241.3
8132/10.80.7,5.6	10	80	7.5	6	123.8	328.6

The load ratings listed here apply to accuracy class T5.
Use factor 0.9 for T7 and factor 0.7 for T10 in order to reduce load ratings.



L [mm]	ø D1 [mm]	L11 [mm]	ø D11 [mm]	L12 [mm]	ø D12 [mm]	L13 [mm]	ø D13 [mm]
57.5	32	16.5	M30x1.5	10.5	M6x1	22	4
57.5	38	16.5	M35x1.5	10.5	M6x1	22	4
63.5	42	17	M40x1.5	10.5	M6x1	23	4
61	42	17	M40x1.5	10	M6x1	21	4
65.5	52	19	M48x1.5	10.5	M6x1	23	5
85	52	19	M48x1.5	12	M6x1	43	5
67.5	58	19	M56x1.7	12	M8x1	22.5	5
105.5	65	27	M60x2	13	M8x1	43	6
118	78	29	M72x2	13	M8x1	53	6
118	92	29	M85x2	13	M8x1	53	6
126	120	34	M110x2	15.5	M8x1	53	8

4.3 | SCREW SHAFTS

Order code	Lead P [mm]	Nominal diameter d_N [mm]	Core diameter [mm]	Ball diameter d_W [mm]	Number of threads	Pitch [mm]	Maximum Length [mm]
0035/5.16.3000.3000 T7	5	16	12.9	3.5	1	5	3000
0045/10.16.3000.3000 T7	10	16	12.9	3.5	2	5	3000
0035/5.20.3000.3000 T7	5	20	16.9	3.5	1	5	3000
0045/10.20.3000.3000 T7	10	20	16.9	3.5	2	5	3000
0045/20.20.3000.3000 T7	20	20	16.9	3.5	4 (2)	5 (10)	3000
0035/5.25.6000.6000 T7	5	25	21.9	3.5	1	5	6000
0045/10.25.6000.6000 T7	10	25	21.9	3.5	2	5	6000
0045/20.25.6000.6000 T7	20	25	21.9	3.5	4 (2)	5 (10)	6000
0045/25.25.6000.6000 T7	25	25	21.9	3.5	5 (2)	5 (12.5)	6000
0035/5.32.6000.6000 T7	5	32	28.9	3.5	1	5	6000
0035/10.32.6000.6000 T7	10	32	26.8	6	1	10	6000

Standard accuracy class T7 (T5, T9, T10 upon request).
Additional charge for shorter lengths (cut lengths).
Length tolerance: 3 m -0.05 +0.1 m, 6 m -0.1 +0.15 m.
Straightness 0.2 mm/m spindle shaft.
2 x approx. 10 – 15 cm unhardened area on each screw shaft end.
(Used threads).

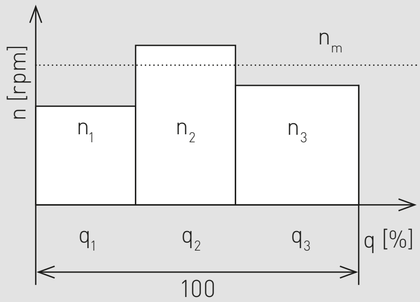


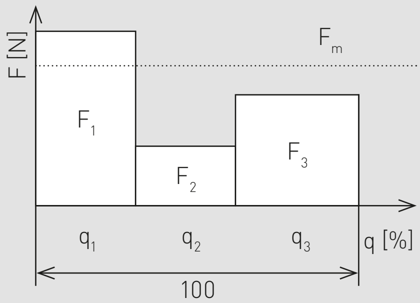
Order code	Lead P [mm]	Nominal diameter d_N [mm]	Core diameter [mm]	Ball diameter d_W [mm]	Number of threads	Pitch [mm]	Maximum Length [mm]
0045/20.32.6000.6000 T7	20	32	26.8	6	2	10	6000
0045/32.32.6000.6000 T7	32	32	26.8	6	4 (2)	8 (16)	6000
0035/5.40.6000.6000 T7	5	40	36.4	3.5	1	5	6000
0035/10.40.6000.6000 T7	10	40	33.3	7.5	1	10	6000
0045/20.40.6000.6000 T7	20	40	34.3	6	2	10	6000
0045/40.40.6000.6000 T7	40	40	33.3	7.5	4 (2)	10 (20)	6000
0035/10.50.6000.6000 T7	10	50	43.3	7.5	1	10	6000
0045/20.50.6000.6000 T7	20	50	43.3	7.5	2	10	6000
0035/10.63.6000.6000 T7	10	63	56.3	7.5	1	10	6000
0045/20.63.6000.6000 T7	20	63	56.3	7.5	2	10	6000
0035/10.80.6000.6000 T7	10	80	73.3	7.5	1	10	6000

5.1 | SERVICE LIFE

5.1.1 | Load capacity selection

Ball screws usually will be used carrying axial loads under dynamic conditions. The selection therefore has to take into consideration the load and the travel - or number of revolutions - made under this load. The normal service life expectancy is based on the fatigue of the material of the balls, and raceways.





5.1.2 | Dynamic axial load capacity C_a

Basically, travel made under higher load will determine the actual service life more than travel made under lower loads. As hardly any application will give a constant load, a mean load must be calculated, which will result in the same service life. This so-called dynamic equivalent axial load F_m is then to be compared with the dynamic axial load capacity C_a.

For simplification, a typical work cycle of the machine under design should be described along with load and load direction, percentage of time and speed for every step.

In the simplest case - non-preloaded single nut - these values can be converted to the dynamic equivalent axial load F_m and the average speed n_m by means of the following formulas:

$$F_m = \left(\frac{q_1 \cdot n_1 \cdot F_1^3 + q_2 \cdot n_2 \cdot F_2^3 + \dots + q_z \cdot n_z \cdot F_z^3}{q_1 \cdot n_1 + q_2 \cdot n_2 + \dots + q_z \cdot n_z} \right)^{1/3} \text{[N]}$$

$$n_m = \left(\frac{q_1 \cdot n_1 + q_2 \cdot n_2 + \dots + q_z \cdot n_z}{q_1 + q_2 + \dots + q_z} \right) \text{[rpm]}$$

F_m = Dynamic equivalent axial Load [N]
F_i = Actual Load [N]
n_i = Actual Speed [rpm]
q_i = Time of each duty cycle [%]
n_m = Average speed [rpm]

The dynamic load capacity for a ball screw listed in the catalog is based on the ISO 3408 / DIN 69051 calculations. This dynamic load capacity is the axial load F_m, under which the ball screw will show a service life of 1 million revolutions (L_{10} rating).

To convert the dynamic load capacity from ISO 3408/DIN 69051 to ANSI 5.48 1977, the following equation should be used.

$$F_m = \frac{C_a}{\left(\frac{L_{10}}{10^6}\right)^{1/3}} \text{ [N]}$$

$$C_a = F_m \cdot \left(\frac{L_{10}}{10^6}\right)^{1/3} \text{ [N]}$$

$$L_{10} = \left(\frac{C_a}{F_m}\right)^3 \cdot 10^6 \text{ [rev.]}$$

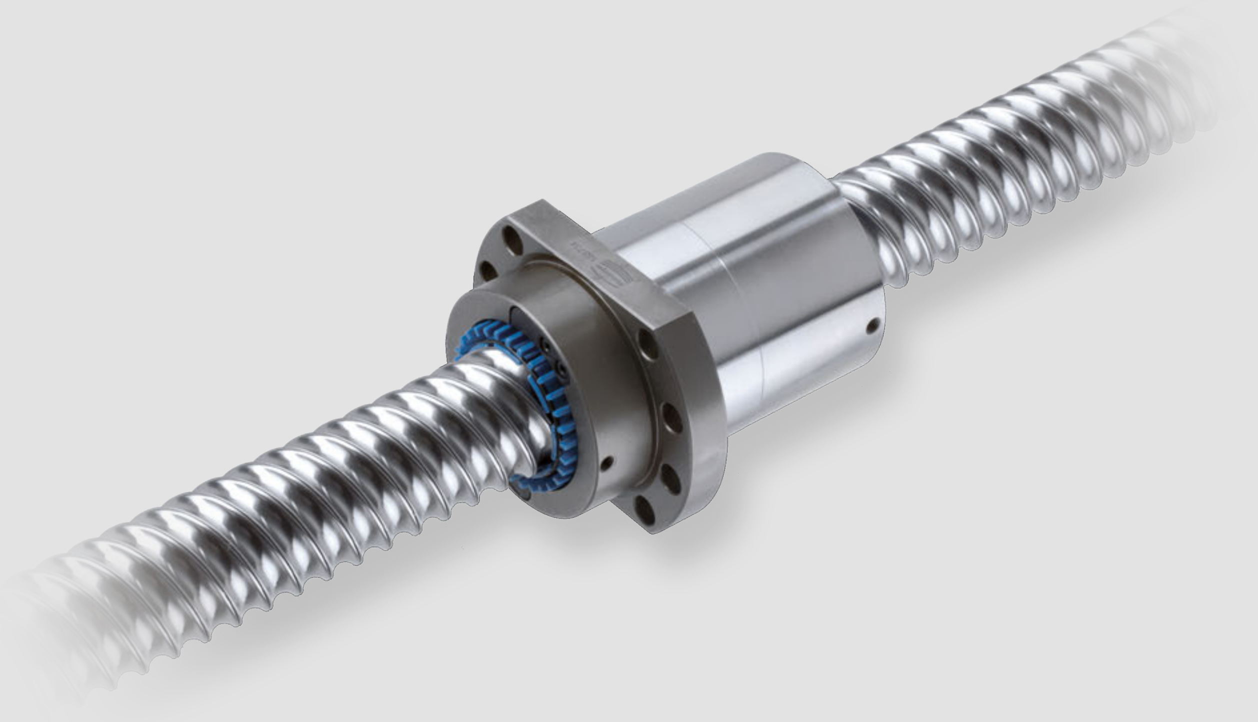
$$C_a = P_i \cdot 4.45 \left(\frac{25.4}{P}\right)^{1/3} \text{ [N]}$$

F_m = Dynamic equivalent axial load [N]
C_a = Dynamic axial load capacity [N]
L_{10} = Nominal service life [rev.]
P = Lead [mm]
P_i = Dynamic axial load capacity [LBS]: ANSI 5.48

The resulting actual service life expectancy should be in the range of:

$$10^6 \leqq L_{10} \leqq 10^9 \text{ [rev.]}$$

It is not recommended to rely on service life expectancies outside the above range.



5.2 | Static axial load capacity C_{0a}

The axial load Fm, a ball screw can carry under static conditions is limited by the static axial load capacity. Exceeding this value will destroy the ball screw due to permanent deformation.

5.3 | Radial loads

Ball screws are designed to take axial loads. The load capacities given in this catalog apply only to pure axial loading!

As there are always tolerances in the alignment of bearings and linear guideways, there may be a small amount of radial force, which should be minimized. Under normal conditions, a radial load less than 5% of the minimum axial load will not cause any problems.

When considering a ball screw for use under radial load, please consult Steinmeyer engineers.

5.4 | Stiffness

Besides the pure geometric accuracy the precision in position is mainly influenced by the stiffness (rigidity) of a ball screw drive.

For ball screws, the best values in stiffness will be reached by using preloaded nuts by ball oversize.

5.5 | Critical column load

Besides the service life calculations regarding the fatigue of the balls there may be further restrictions of the maximum axial loads. First the axial load should never exceed the static load capacity, as this will cause immediate permanent damage to the ball screw.

Secondly for very long and slim screws, the critical column load needs to be considered.

For easily calculating the bucking load, the following approximation may be used:

$$P_B = (m \cdot d_N^4 / l_s^2) \cdot 10^4 \text{ [N]}$$

P_B = Buckling load [N]
d_N = Nominal diameter of ball screw [mm]
l_s = Length of unsupported shaft [mm]
m= Coefficient of bearing configuration

fixed - fixed:	22.4
fixed - supported:	11.2
supported - supported:	5.6
fixed - free:	1.4

For safety reasons, a factor of 0.5 must be applied:

$$F_{max} = P_B \cdot 0.5$$

5.6 | Critical speeds

The critical speed is the speed at which the screw begins to vibrate due to resonance.

For rotating screws, the critical speed depends on the screw diameter, length, and bearing configuration.

For quickly determining the critical speed the following approximation can be used for calculation:

$$n_k = F \cdot d_N \cdot (1/l_s^2) \cdot 10^7 \text{ [rpm]}$$

n_k = Critical speed [rpm]
d_N = Nominal diameter of ball screw [mm]
l_s = Length of unsupported shaft [mm]
F = Coefficient of bearing configuration

fixed - fixed:	25.5
fixed - supported:	17.7
supported - supported:	11.5
fixed - free:	3.9

For safety reasons, a factor of 0.8 must be applied:

$$n_{max} = n_k \cdot 0.8$$

DRIVING POSITIONING MEASURING

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