FineLine Ball Screws

Manufactured using BS&A's PSF Technology™

Solutions by DanaherMotion

BSA®

FineLine **Ball Screws**

The high precision alternative to costly ground ball screws.

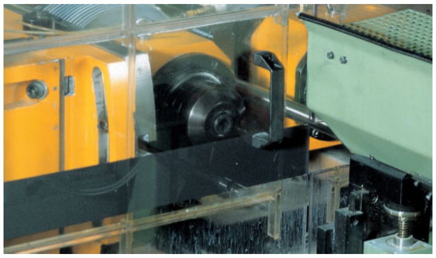
FineLine Ball Screws were developed by BS&A (previously known as Warner Linear) in Wolfschlugen, Germany, and have been sold in Europe since 1999. The screws have been successfully deployed in high-precision applications in transporation, manufacturing, health, fitness, robotics, plastics and packaging industries. BS&A's PSF Technology™ enables us to manufacture ball screws with accuracy and performance in the same class as precision ground screws, yet without the extreme expense of grinding processes.

Exclusive PSF Technology™

Precision Screw Forming (PSF) Technology is based on a proprietary process of precision roll forming. Through years of research, development and partnering with steel suppliers and equipment manufacturers we have developed a CNC-based rolling process. At the heart of the process is the ability to dynamically control both roller dies as well as other variables in the manufacturing process. The end result of this German-engineered process is the production of highly cost effective rolled product with capabilities equaling those normally attributed only to ground screws.

Features and Benefits

- **Accuracy**: Available in ISO accuracy grades P3 and P5 (permissible travel variation of 12 µm/300 mm and 23µm/300 mm, respectively), as well as in transport grades T5 and T7.
- **Smooth operation**: Made of high carbon alloy steel that we induction harden, stress relieve, and then polish to insure excellent operating smoothness.
- **Quiet operation:** High degree of accuracy and exceptional surface finish assure quiet operation.
- **Consistent running torque**: Precise screw cylindricality and ball-track roundness (max. deviation of 3 to 6 µm), both of which are necessary for consistent running torque in critical applications such as machine tool slides.
- **Preloads**: Can be supplied with customer-specified preloads from zero to 13% of the dynamic load rating.
- **Flanges and Finish Machining**: Available with flanged and non-flanged nut assemblies and machined standard end journals.



BS&A FineLine Ball Screws

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Technical Overview
& Functional Highlights

Precision Screw Forming Technology™

BS&A's patented, German-engineered Precision Screw Forming (PSF) Technology has created a higher performing ball screw, combining outstanding precision—traditionally only associated with ground screws—with the manufacturing efficiency of rolled processes. The result is an affordable ball screw with highest precision and outstanding performance.

BS&A FineLine ball screws are equal in accuracy and performance to ground screws of the same accuracy class, but with harder grain structures (see inset), lower costs, and short manufacturing times (provides significantly reduced lead times for our customers). PSF Technology consistently produces screws with accuracies ranging up to P3 class tolerances (ISO 3408 standard), a dramatic improvement over existing rolled manufacturing processes that typically produce only transport-grade screws (up to class 7). PSF Technology brings affordable precision to a range of new applications.

What is PSF Technology?

Precision Screw Forming is an exacting manufacturing process that results in a superior ball screw. First, high carbon alloy steel blanks are processed into screws of length up to four meters (over 13 feet) in a special CNC-controlled, dual-movable-die, cold-forming machine. Second, the screw forms are induction-hardened and stress-relieved. Next, the screws are polished to produce a ball track with surface toughness superior to a ground screw. Finally, the ball screw is mated with its nut (loaded to user specifications), inspected and tested to customer requirements. The result is a high precision, high quality ball screw/nut assembly.

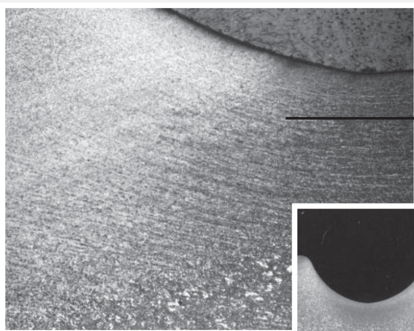
What are the Benefits of PSF Technology?

Here are just some of the benefits associated with ball screws made using PSF Technology:

1. FineLine ball screws offer low cost, high precision performance in applications typically requiring ground screws. FineLine also offers the opportunity for greater precision in applications where ground screws have been too expensive to consider.
2. Responsive manufacturing & delivery times: PSF Technology is a fast, non-batch manufacturing process, with delivery times of less than two weeks, compared with the typical 2-3 month lead times of ground ball screws.
3. No hard spots: The PSF process does not expose hard spots ("corns") as grinding does. Hard spots can mar ball surfaces and shorten screw life by up to 20%.
4. Quieter running: The superior surface finish of FineLine ball screws gives smooth operations with minimal noise.

FineLine Ball Screws – Better Grain Structures

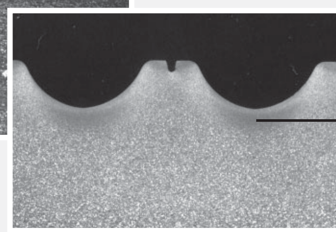
In addition to equaling some of the top accuracy classes of ground screws, our FineLine Ball Screws offer a distinct advantage over ground screws in the screw's arch. Screw rolling displaces grains, producing arch-shaped grain structures, while grinding removes material and leaves asperities exposed in the grain structure. FineLine rolled screws thus have increased rust resistance, and a stronger, arched grain structure that induces hardness under the surface of the screw.



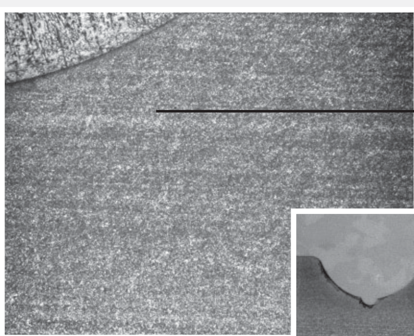
Micrograph shows smooth, arched grain structure of a screw manufactured using PSF Technology.

FineLine Ball Screws with PSF Technology

Arched grain provides increased strength, hardness and durability, resulting in reduced friction and increased life.



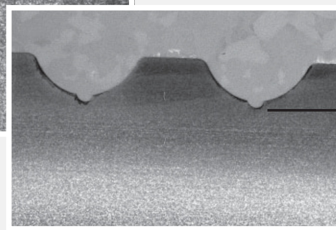
Profile of a rolled PSF Technology screw



Micrograph shows grain structure of a ground screw.

Typical Ground Ball Screw

Grinding the screw reduces the integrity of the steel and leaves exposed asperities in the grain structure, which can reduce efficiency and useful life.



Profile of a ground screw

Accuracy & Precision Classes

Accuracy is a measure of how closely a motion system will approach a command position. Perfect accuracy, for example, means that advancing a ball nut a precise amount from a given point on the screw always requires exactly the theoretically predicted number of revolutions.

Accuracies may be specified by users in two ways.

- *Standards* have been developed for simplicity in grouping sets of accuracies. Tolerance classes have been established by ISO/DIN for the purpose of easily describing lead accuracies for ball screws.
- *Absolute terms* may define accuracies such as .0005 in/ft deviation (typically shown as tolerances on a drawing).

FineLine ball screws are produced in two main tolerance classes: T (transport) and P (positioning). *Transport grade* ball screws are used in applications requiring only coarse movement or those utilizing linear feedback for position location. As such, most transport grade screws are provided with nuts having backlash (T7 grade screws cannot be supplied with preloaded nuts). *Precision grade* ball screws are used where repeatable positioning within microns is critical, without the use of a linear feedback device.

Differences between P & T grades are highlighted in the graph above. T grade transport screws allow greater cumulative variation over the useful length of the screw. P grade positioning screws contain accumulation of lead error to provide precise positioning over the screw's entire useful length.

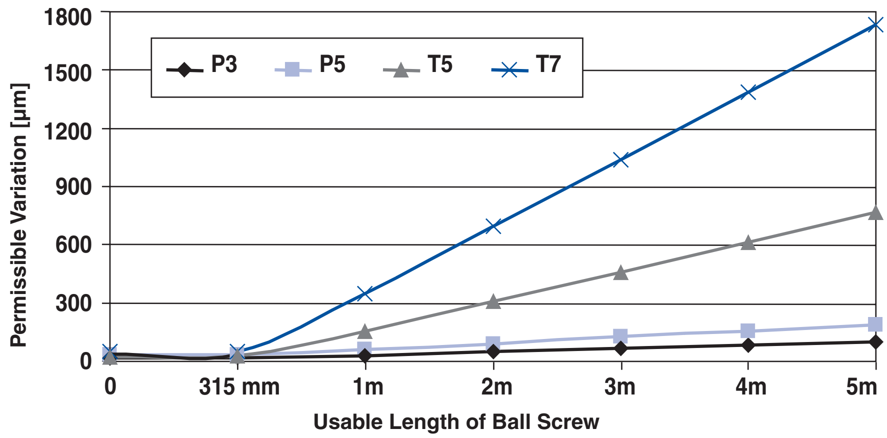
Position grade screws are used in applications such as CNC milling machines, medical imaging equipment, and lens grinding devices. In contrast, transport grade screws are used to drive door actuators or assembly line diverter gates.

For additional information, see page 26 in the engineering reference section.

Allowable Variation Per Tolerance Class

Tolerance Class	Permissible travel variation within 300 mm		Variation within one revolution (2π rad)	
	[µm]	[in.]	[µm]	[in.]
P3	12	.0005	6	.0002
P5	23	.0009	8	.0003
T5	23	.0009	8	.0003
T7	52	.0020	12	.0005

Cumulative Lead Variation Over Usable Length

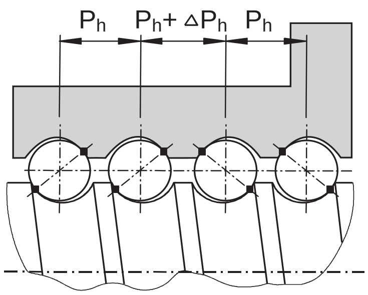


Preload Classes

FineLine Ball Screws are available in three preload classes: Clearance Grade (no preload), Preload (lightly preloaded with four points of contact) and Precise Preload (preloaded with two points of contact to exact customer specifications).

Precise Preload (Type Z0)

(Precisely preloaded to customer specifications)



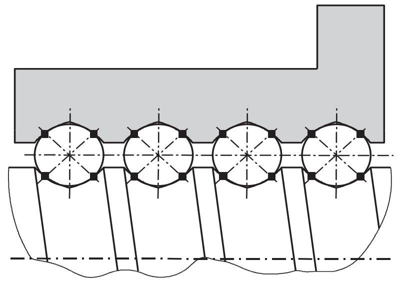
Precise Preload
The lead is offset by an amount, ΔP_h, to preload with two points of contact around the balls as shown.

- Offers zero backlash between screw and nut.
- The preload is approximately 10% of dynamic load capacity, but can range from 2% to 13% as specified by customers. Drag torque is controlled within a designated range.
- Typically used for positioning applications where repeatability and high stiffness are required (high stiffness allows for high load carrying with minimum deflection).

(Available only with FL nut.)

Preload (Type Z1)

(Lightly preloaded)



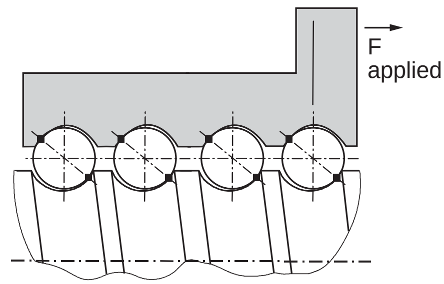
Preloaded
Oversized balls slightly larger than the ball groove space are used to provide four points of contact.

- Offers zero backlash between screw and nut.
- The preload is approximately 5% of dynamic load capacity.
- Typically used for positioning applications where repeatability is critical.

(Available with FK, FH & ZG style nuts.)

Clearance Grade (Type Z2)

(No Preload)



No Preload
Ball bearings are undersized, thereby creating clearance between the nut and screw.

- Axial play is present between screw and nut, which negatively affects repeatability.
- Introduces no additional drag torque.
- Lead accuracy is unaffected, repeatability is approximately equal to backlash amount. (Typical maximum backlash is .09 to .18 mm, depending on size.)
- Typically used for transport applications or vertical applications where low drag is desirable.

(Available with FK, FH & ZG style nuts.)

Technical Overview & Functional Highlights

Ball Recirculation Techniques

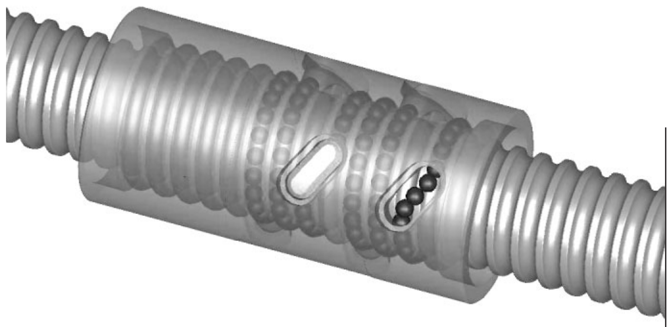
A critical aspect of ball nut design is the manner in which the ball bearings are recirculated through the nut.

BS&A has done extensive research on ball nut design, and has engineered two internal return systems: the single-liner ball return system and the end-cap ball return system. Internal systems are compact, offer no protrusions to complicate mounting, are less likely to be damaged, and are designed to optimize ball circulation and rotational speed.

The *single-liner* design allows the balls to travel one rotation about the screw before being diverted into the insert and back one thread pitch. Four or more liners are used to provide the necessary number of loaded turns to achieve the desired load capacity. Successive liners are typically staggered circumferentially about the body of the nut to balance the total ball contact around the screw. The simplicity of design and economy of motion result in a compact and reliable ball return assembly. The return design is primarily used on fine lead screws.

For higher leads, *end-cap* designs are preferable. The balls are allowed to rotate around the screw for the length of the nut before being re-directed by the end cap. This internal return channel runs from one end of the nut to the other and carries the balls back to the beginning of the circuit. The second end cap re-engages the balls with the screw, completing the circuit. The end cap design eliminates dead zones in the ball nut and optimizes load capacity. Rotational speed is enhanced through the geometry of the end cap diverter and the few number of returns required.

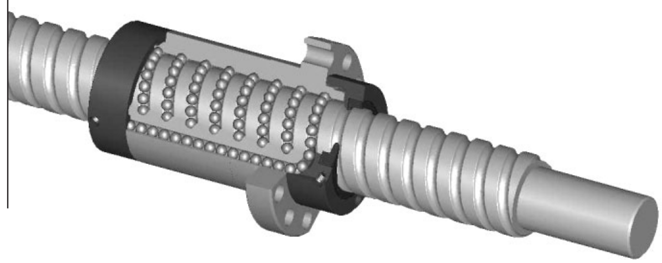
Single-Liner Ball Return System



The single-liner ball return design is used for the FK, FL & ZG type nuts.

End-Cap Ball Return System

The end-cap design offers distinct advantages and is the system used for the FH type nuts



FineLine Ball Screws Product Specifications Metric Unit Sizes

Product Specifications

Metric Unit Sizes: Part Numbers

End Machining

P - M - 25 - 05 - 0095 - FK - P5 - Z1 - A - E

First End | Second End

Screw Assembly Type
P = Precision Ball Screws

Unit
M= Metric Assembly

Screw Size
Nominal Diameter [mm]
12
16
20
25
32
40
50
63
80

Screw Lead
[mm/rev]
4
5
10
20
25
40

Length
[mm]
See **Max Length** on specification pages.

Nut Type
FK = Flange Nut (low lead)
FH = Flange Nut (high lead)
FL = Precision Flange Nut
ZG = Threaded Nut

Accuracy Class
(see page 4)
P3
P5
T5
T7

Nut Loading
(see page 5)
Z0.XX = Precise Preload (Select 1%-13%. Available only with FL nut)*
Z1 = Preload
Z2 = No Preload

Standard End Journals
(see page 16)
A = Fixed End
B = Simple End
C = Fixed End w/ Drive Journal
D = Fixed End w/ Drive Journal and Keyway
E = Free End

*For FL nut loading, the number selected indicates the preload force as a percentage of dynamic load capacity. For example, a 12% preload would be "Z0.12".

FineLine **Ball Screw Assembly Availability**

Metric Series Availability

Nominal Diameter [mm]	Nut Type	Nominal lead d_0 [mm/rev]					
		4	5	10	20	25	40
12	FH						
	FK						
	ZG	●					
	FL						
16	FH						
	FK		●				
	ZG		●				
	FL		○				
20	FH				●		
	FK		●				
	ZG		●				
	FL		○				
25	FH			●		●	
	FK		●				
	ZG		●	●			
	FL		○				
32	FH				●		
	FK		●	●			
	ZG		●	●			
	FL		○	○			
40	FH				●		●
	FK		●	●			
	ZG		●	●			
	FL		○	○			
50	FH				●		
	FK			●			
	ZG			●			
	FL			○			
63	FH				○		
	FK			○			
	ZG			○			
	FL			○			
80	FH						
	FK			○			
	ZG			○			
	FL			○			

● in stock ○ available non-stock

Ball Nut Types

FK (flanged nut, standard lead)

See page 10.

- Available with preload or no preload
- Shortest nut length possible
- Excellent economical solution

FH (flanged nut, high lead)

See page 10.

- Available with preload or no preload
- Shortest nut length possible
- Excellent economical solution

ZG (threaded nut)

See page 12.

- Available with preload or no preload
- Solution for non-standard mounting

FL (precision, flanged nut)

See page 14.

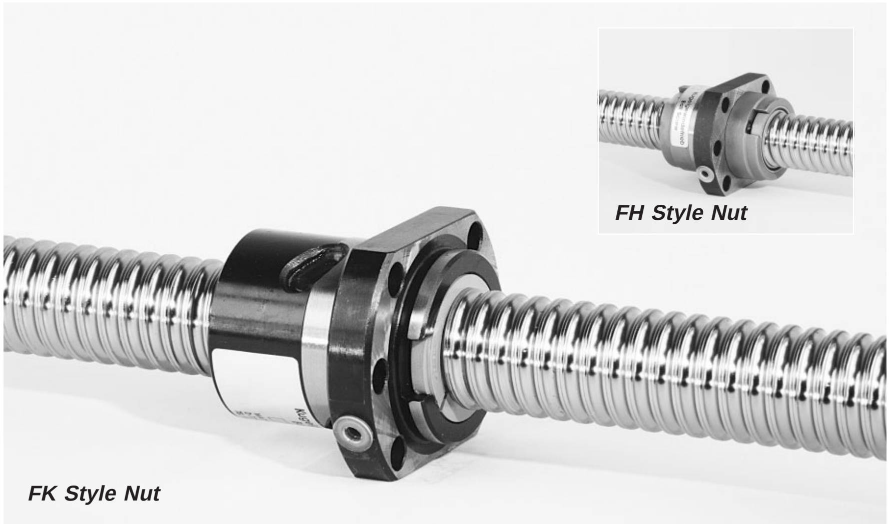
- Available with precise preload
- Excellent rigidity
- Highest precision

Product Specifications

BS&A is continually developing additional size offerings.
Contact us if your desired size is not listed.

FK & FH

Standard Flanged Ball Nuts—Clearance & Preload Grade



Standard Flanged Ball Nut and Screw

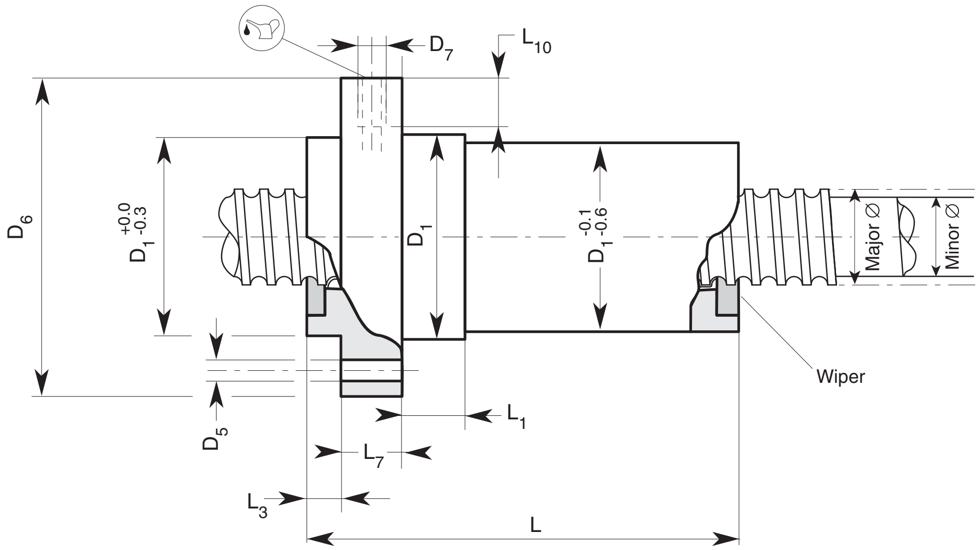
- Available with preload or no preload
- Shortest nut length possible
- Excellent economical solution

Performance Specifications for ball screws with Flanged Ball Nuts
Metric Series

Nom. Diam.	Lead	Nut Type	Performance Data					Screw Dimensions				
			Dynamic Load Capacity (C_{am})		Static Load Capacity (C_{0am})		Max Axial Backlash	Major ∅	Minor ∅	Max Length	Screw Weight	
d_0 [mm]	P_{h0} [mm]		[kN]	[lbf]	[kN]	[lbf]	[mm]	[mm]	[mm]	[mm]	[kg/m]	[lb/ft]
16	5	FK	9.5	2136	10.9	2450	0.09	15.6	12.7	3000	1.2	0.81
20	5	FK	11.5	2585	15.5	32484	0.09	19.6	16.7	4000	2	1.34
20	20	FH	11.5	2585	17.5	3934	0.09	19.6	16.7	4000	1.9	1.28
25	5	FK	13.1	2945	20.2	4541	0.09	24.6	21.7	5000	3.3	2.22
25	10	FH	22.9	5148	141.2	31742	0.09	24.6	21.7	5000	3.3	2.22
25	25	FH	13	2922	22.6	5080	0.09	24.6	21.7	5000	3.3	2.22
32	5	FK	19.3	4339	363	81602	0.09	31.6	287	6000	5.6	3.76
32	10	FK	26.4	5935	39	8767	0.15	31.6	27.1	6000	5.3	3.56
32	20	FH	47.2	10611	83.2	18703	0.15	31.6	27.1	6000	5.3	3.56
40	5	FK	26.3	5912	59.2	13308	0.09	39.6	36.7	6000	9	6.05
40	10	FK	64.9	14590	109	24503	0.18	39.6	34	6000	8.3	5.58
40	20	FH	52.2	11735	103.6	23289	0.15	39.6	35.2	6000	7.6	5.11
40	40	FH	59.7	13421	108.9	24481	0.18	39.6	34	6000	8.4	5.64
50	10	FK	66.4	14927	134.3	30191	0.18	49.5	43	6000	13.5	9.07
50	20	FH	78.8	17714	188.7	42420	0.16	49.5	446	6000	13.6	9.14
63	10	FK	93.8	21086	229.7	51637	0.18	62.5	56.9	6000	22	14.78
63	20	FH	103.1	23177	270.8	60876	0.18	62.5	56.9	6000	22	14.78
80	10	FK	121.9	27404	374.9	84281	0.18	79.5	73.9	6000	36.4	24.6

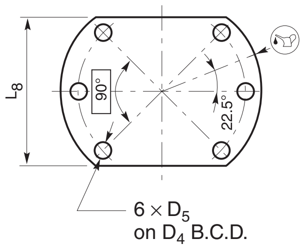
Note: All listed products available in P3, P5, T5 & T7 accuracy classes.

Standard Flanged Ball Nuts—Clearance & Preload Grade

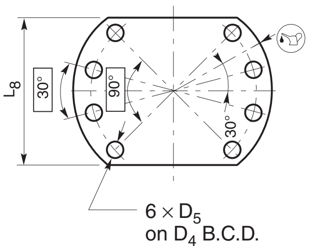


	D_7	L_{10}
$d_0 < 40$ mm	M6 x 1	8
$d_0 \geq 40$ mm	M8 x 1	10

$d_0 < 40$ mm



$d_0 \geq 40$ mm



Dimensional Specifications for ball screw nuts (Flanged Ball Nuts)

Nom. Diam. d_0 [mm]	Lead P_{h0} [mm]	Nut Type	D_1 g_6	D_4	D_5	D_6 h_{12}	L ±1	L_1 +2	L_3 -0.5	L_7 h_{13}	L_8 h_{13}	Nut Weight [kg]	Nut Weight [lbm]	Ball Ø (D_w) [mm]
16	5	FK	28	38	5.5	48	48.5	10	5.5	10	40	0.25	0.55	3.500
20	5	FK	36	47	6.6	58	48.5	10	5.5	10	44	0.35	0.77	3.500
20	20	FH	36	47	6.6	58	59	20	14	10	44	0.45	0.99	3.500
25	5	FK	40	51	6.6	62	49	10	6	10	48	0.37	0.82	3.500
25	10	FH	40	51	6.6	62	51	9	16	10	48	0.45	0.99	3.500
25	25	FH	40	51	6.6	62	71	20	15.5	10	48	0.55	1.21	3.500
32	5	FK	50	65	9	80	57	10	6	12	62	0.7	1.54	3.500
32	10	FK	50	65	9	80	73	16	6	12	62	0.8	1.76	5.556
32	20	FH	56	71	9	86	83	25	19	12	68	1.4	3.09	5.556
40	5	FK	63	78	9	93	66	10	7	14	70	1.2	2.65	3.500
40	10	FK	63	78	9	93	88.5	16	7	14	70	1.4	3.09	7.144
40	20	FH	63	78	9	93	83	25	19.5	14	70	1.6	3.53	5.556
40	40	FH	70	85	9	100	104	25	21	14	77	2.4	5.29	7.144
50	10	FK	75	93	11	110	92	16	7	16	85	2	4.41	7.144
50	20	FH	75	93	11	110	85	16	22	16	85	2.2	4.85	6.350
63	10	FK	90	108	11	125	103.5	16	7	18	95	3	6.61	7.144
63	20	FH	95	115	13.5	135	86	18	24	20	100	3.8	8.38	7.144
80	10	FK	105	125	13.5	145	121	16	9	20	110	3.9	8.6	7.144

Standard Threaded Ball Nuts—Clearance & Preload Grade

ZG Style Nut

Standard Threaded Ball Nut and Screw

- Available with preload or no preload
- Solution for non-standard mounting

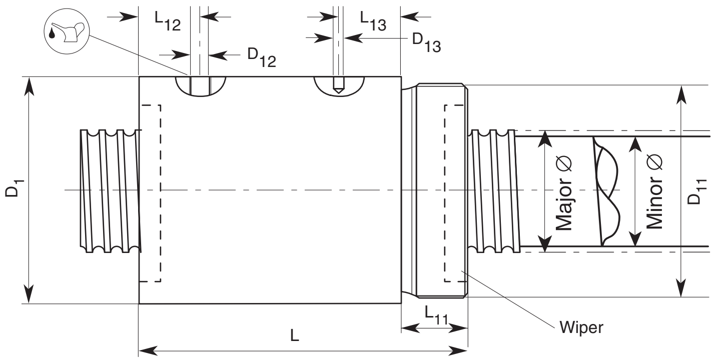
Performance Specifications for ball screws with Threaded Ball Nuts

Metric Series

Nom. Diam.	Lead	Nut Type	Performance Data					Screw Dimensions				
d_0	P_{h0}		Dynamic Load Capacity (C_{am})		Static Load Capacity (C_{0am})		Max Axial Backlash	Major ∅	Minor ∅	Max Length	Screw Weight	
[mm]	[mm]		[kN]	[lbf]	[kN]	[lbf]	[mm]	[mm]	[mm]	[mm]	[kg/m]	[lb/ft]
12	4	ZG	3.5	787	4	899	0.07	11.6	9.7	3000	0.7	0.47
16	5	ZG	12.1	2720	14.5	3260	0.09	15.6	12.7	3000	1.2	0.81
20	5	ZG	14.8	3327	20.7	4653	0.09	19.6	16.7	4000	2	1.34
25	5	ZG	20.4	4586	33.7	7576	0.09	24.6	21.7	5000	3.3	2.22
25	10	ZG	19.9	4474	31.8	7149	0.09	24.6	21.7	5000	3.3	2.22
32	5	ZG	23.3	5238	45.5	10228	0.09	31.6	287	6000	5.6	3.76
32	10	ZG	33.8	7598	52	11690	0.15	31.6	27.1	6000	5.3	3.56
40	5	ZG	26.3	5912	59.2	13308	0.09	39.6	36.7	6000	9	6.05
40	10	ZG	78.6	17669	136.2	30618	0.18	39.6	34	6000	8.3	5.58
50	10	ZG	97.8	21985	213.2	47927	0.18	49.5	43	6000	13.5	9.07
63	10	ZG	109.7	24661	275.6	61955	0.18	62.5	56.9	6000	22	14.78
80	10	ZG	121.9	27403	375	84300	0.18	79.5	73.9	6000	36.4	24.46

Note: All listed products available in P3, P5, T5 & T7 accuracy classes.

Standard Threaded Ball Nuts—Clearance & Preload Grade



Dimensional Specifications for ball screw nuts (Threaded Ball Nuts)

Nom. Diam. d_0 [mm]	Lead P_{h0} [mm]	Nut Type	D_1 h_{12}	D_{11}	D_{12}	D_{13} ±0.1	L ±1	L_{11} -0.5	L_{12} ±2	L_{13} ±2	Nut Weight [kg]	Nut Weight [lbm]	Ball Ø (D_w) [mm]
12	4	ZG	25.5	M 20 x 1.0	3.2	-	34	10	12.0	-	0.1	0.22	1.984
16	5	ZG	32	M 30 x 1.5	M 6 x 1	4	57.5	16.5	10.5	22.0	0.22	0.49	3.500
20	5	ZG	38	M 35 x 1.5	M 6 x 1	4	57.5	16.5	10.5	22.0	0.3	0.66	3.500
25	5	ZG	42	M 40 x 1.5	M 6 x 1	4	63.5	17	10.5	23.0	0.37	0.82	3.500
25	10	ZG	42	M 40 x 1.5	M 6 x 1	4	61	17	10.0	21.0	0.38	0.84	3.500
32	5	ZG	52	M 48 x 1.5	M 6 x 1	5	65.5	19	10.5	23.0	0.55	1.21	3.500
32	10	ZG	52	M 48 x 1.5	M 6 x 1	5	85	19	12.0	43.0	0.65	1.43	5.556
40	5	ZG	58	M 56 x 1.5	M 8 x 1	5	67.5	19	12.0	22.5	0.6	1.32	3.500
40	10	ZG	65	M 60 x 2.0	M 8 x 1	6	105.5	27	13.0	43.0	1.25	2.76	7.144
50	10	ZG	78	M 72 x 2.0	M 8 x 1	6	118	29	13.0	53.0	1.95	4.30	7.144
63	10	ZG	92	M 85 x 2.0	M 8 x 1	6	118	29	13.0	53.0	2.4	5.29	7.144
80	10	ZG	120	M 110 x 2.0	M 8 x 1	8	126	34	15.5	53.0	4.9	10.8	7.144

Flanged Ball Nuts—Precise Preload Grade

FL Style Nut

Flanged Ball Nut and Screw

- Available with precise preload
- Excellent rigidity
- Highest precision

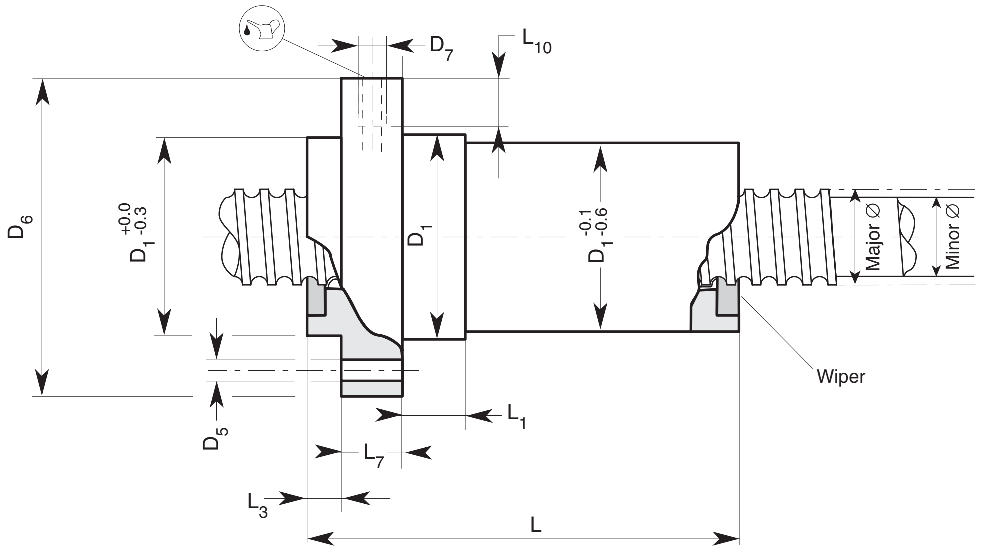
Performance Specifications for ball screws with Flanged Ball Nuts

Metric Series

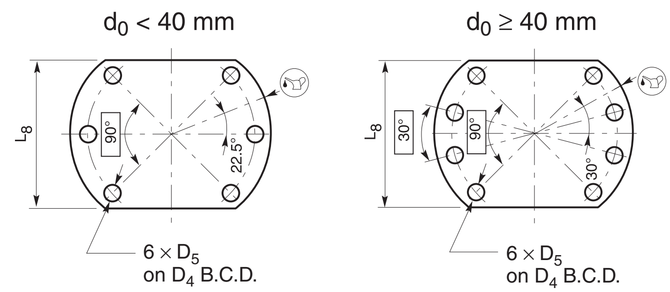
Nom. Diam.	Lead	Nut Type	Performance Data						Screw Dimensions					
d_0	P_{h0}		Dynamic Load Capacity (C_{am})		Static Load Capacity (C_{0am})		Min. Stiffness (R_{nu})*	Max Axial Backlash	Number of Loaded Turns	Major Ø	Minor Ø	Max Length	Screw Weight	
[mm]	[mm]		[kN]	[lbf]	[kN]	[lbf]	[kN/μm]	[mm]		[mm]	[mm]	[mm]	[kg/m]	[lb/ft]
16	5	FL	6.7	1506	7.2	1619	0.16	0.00	2 + 2	15.6	12.7	3000	1.2	0.81
20	5	FL	11.5	2585	15.5	3484	0.30	0.00	3 + 3	19.6	16.7	4000	2	1.34
25	5	FL	12.6	2832	19.1	4294	0.38	0.00	3 + 3	24.6	21.7	5000	3.3	2.22
32	5	FL	19.3	4339	36.4	8183	0.60	0.00	4 + 4	31.6	287	6000	5.6	3.76
32	10	FL	26.4	5935	39	8767	0.49	0.00	3 + 3	31.6	27.1	6000	5.3	3.56
40	5	FL	26.3	5912	59.2	13308	0.89	0.00	5 + 5	39.6	36.7	6000	9	6.05
40	10	FL	64.9	14590	109	24503	0.94	0.00	4 + 4	39.6	34	6000	8.3	5.58
50	10	FL	66.4	14927	134.3	30191	1.18	0.00	4 + 4	49.5	43	6000	13.5	9.07
63	10	FL	93.8	21086	229.7	51637	1.74	0.00	5 + 5	62.5	56.9	6000	22	14.78
80	10	FL	121.9	27404	375	84303	2.45	0.00	6 + 6	79.5	73.9	6000	36.4	24.6

Note: FL listed products available in P3 accuracy class only.
*Nut stiffness based on 10% preload (F=10% × C_{am}).

Flanged Ball Nuts—Precise Preload Grade



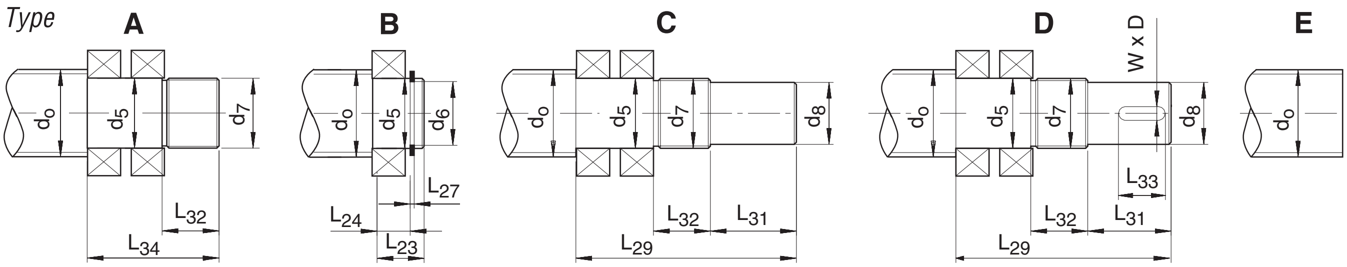
	D_7	L_{10}
d_0 < 40 mm	M6 x 1	8
$d_0 \geq$ 40 mm	M8 x 1	10



Dimensional Specifications for ball screw nuts (Flanged Ball Nuts)

Nom. Diam.	**Lead**	**Nut Type**	**Nut Dimensions** [mm]									**Nut Weight**		**Ball Ø (D_w)**
d_0 [mm]	P_{h0} [mm]		D_1 g_6	D_4	D_5	D_6 h_{12}	L ±1	L_1 +2	L_3 -0.5	L_7 h_{13}	L_8 h_{13}	[kg]	[lbm]	[mm]
16	5	FL	28	38	5.5	48	55	10	5.5	10	40	0.21	0.46	3.500
20	5	FL	36	47	6.6	58	68.5	10	5.5	10	44	0.38	0.84	3.500
25	5	FL	40	51	6.6	62	69.5	10	6	10	48	0.38	0.84	3.500
32	5	FL	50	65	9	80	83	10	6	12	62	0.72	1.59	3.500
32	10	FL	50	65	9	80	105.5	16	6	12	62	0.82	1.81	5.556
40	5	FL	63	78	9	93	97	10	7	14	70	1.3	2.87	3.500
40	10	FL	63	78	9	93	142	16	7	14	70	1.5	3.31	7.144
50	10	FL	75	93	11	110	144	16	7	16	85	2.2	4.85	7.144
63	10	FL	90	108	11	125	166	16	7	18	95	3.3	7.28	7.144
80	10	FL	105	125	13.5	145	192	16	9	20	110	4.3	9.48	7.144

Standard End Journals



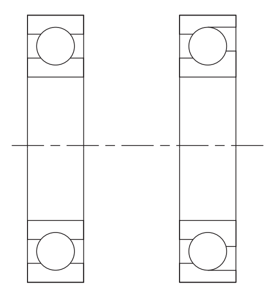
Fixed End | *Simple End* | *Fixed End with Drive Journal* | *Fixed End with Drive Journal and Keyway* | *Free End*

Specifications for standard end journals [mm]

d_0	d_5 j_6	d_6 h_{12}	d_7	d_8 h_7	L_{23}	L_{24}	L_{27} h_{13}	L_{29}	L_{30}	L_{31}	L_{32}	L_{34}	W x L_{33} x D
16	12	11.5	M12 x 1.0	10	10.5	8	1.1	59	35.5	25	10	33	3 x 18 x 1.8
20	15	14.0	M15 x 1.0	12	13	9	1.1	62	48	35	12	37	4 x 27 x 2.5
25	20	19.0	M20 x 1.0	16	16	12	1.3	86	61	45	14	41	5 x 36 x 3
32	25	23.9	M25 x 1.5	20	19	15	1.3	104	74	55	17	49	6 x 45 x 3.5
40	30	28.6	M30 x 1.5	25	21	16	1.6	117	85	64	17	53	8 x 50 x 4
50	40	37.5	M40 x 1.5	36	25	18	1.85	143	96	78	21	65	10 x 63 x 5
63	50	47.5	M50 x 1.5	40	27	20	2.0	169	127	100	25	70	12 x 78 x 5
80	60	57.5	M60 x 2.0	50	29	22	2.15	201	149	120	30	81	14 x 100 x 5.5

Bearings & Lock Nuts for recommended end journal bearings

d_0 [mm]	**End Journal Type B:** DIN 625	**End Journal Types A, C:** DIN 628	**Lock Nut:** DIN 631
16	6001	7301 B	KM 1
20	6002	7302 B	KM 2
25	6004	7204 B	KM 4
32	6205	7305 B	KM 5
40	6206	7306 B	KM 6
50	6208	7308 B	KM 8
63	6210	7310 B	KM 10
80	6212	7312 B	KM 12



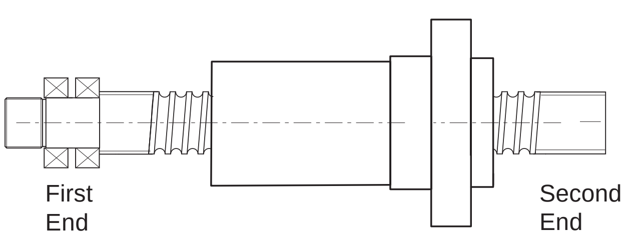
DIN 625 DIN 628

End Journal Orientation

End Machining

P - M - 25 - 05 - 0095 - FK - P5 - Z1 - A - E

First End | Second End



Standard End Journal Types
- **A** = Fixed End
- **B** = Simple End
- **C** = Fixed End w/Drive Journal
- **D** = Fixed End w/Drive Journal and Keyway
- **E** = Free End

Note: Ball nut orientation as shown

See page 8 for complete explanation of part numbering.

New

FineLine Ball Screws Product Specifications English Unit Sizes

Product Specifications

English Unit Sizes: Part Numbers

End Machining

P - E - 625 - 200 - 16.50 - ZG - P5 - Z1 - A - E

First End / Second End

Screw Assembly Type
P = Precision Ball Screws

Unit
E = English Assembly (Inch Lead)

Screw Size
Nominal Diameter [in x 1000]
625

Screw Lead
[in x 1000/rev]
200
500
1000

Screw Length
[in]
See **Max Length** on specification pages.

Nut Type
FK = Flange Nut (low lead)
FH = Flange Nut (high lead)
FL = Precision Flange Nut
ZG = Threaded Nut

Accuracy Class
(see page 4)
P3
P5
T5
T7

Nut Loading
(see page 5)
Z0.XX = Precise Preload (Select 1%-13%. Available only with FL nut)*
Z1 = Preload
Z2 = No Preload

Standard End Journals
(see page 16)
A = Fixed End
B = Simple End
C = Fixed End w/ Drive Journal
D = Fixed End w/ Drive Journal and Keyway
E = Free End

FineLine Ball Screw Assembly Availability - English Series

Nominal Diameter [in]	Nut Type	Nominal lead d_0 [in/rev]		
		.200	.500	1.000
.625	FK	○		
	ZG	●		
	FL	○		

● in stock ○ available non-stock.

BS&A is continually developing additional size offerings.
Contact us if your desired size is not listed.

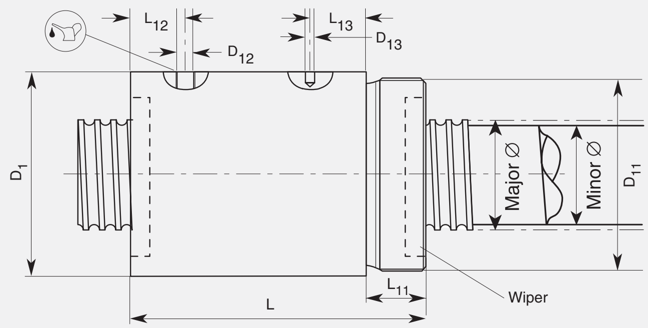
Performance Specifications for ball screws

Nom. Diam.	Lead	Nut Type	Performance Data					Screw Dimensions				
			Dynamic Load Capacity (C_{am})		Static Load Capacity (C_{0am})		Max Axial Backlash	Major ∅	Minor ∅	Max Length	Screw Weight	
d_0 [in]	P_{h0} [in]		[kN]	[lbf]	[kN]	[lbf]	[in.]	[in.]	[in.]	[in.]	[kg/m]	[lb/ft]
.625	.200	ZG	12.1	2720	14.5	3260	0.0035	0.61	0.5	118	1.2	0.81
.625	.200	FK	9.5	2136	10.9	2450	0.0035	0.61	0.5	118	1.2	0.81
.625	.200	FL	6.7	1506	7.2	1619	0.0000	0.61	0.5	118	1.2	0.81

Note: FK and ZG products available in P3, P5, T5 & T7 accuracy classes; FL available in P3 only.

Dimensional Specifications for ball screw nuts

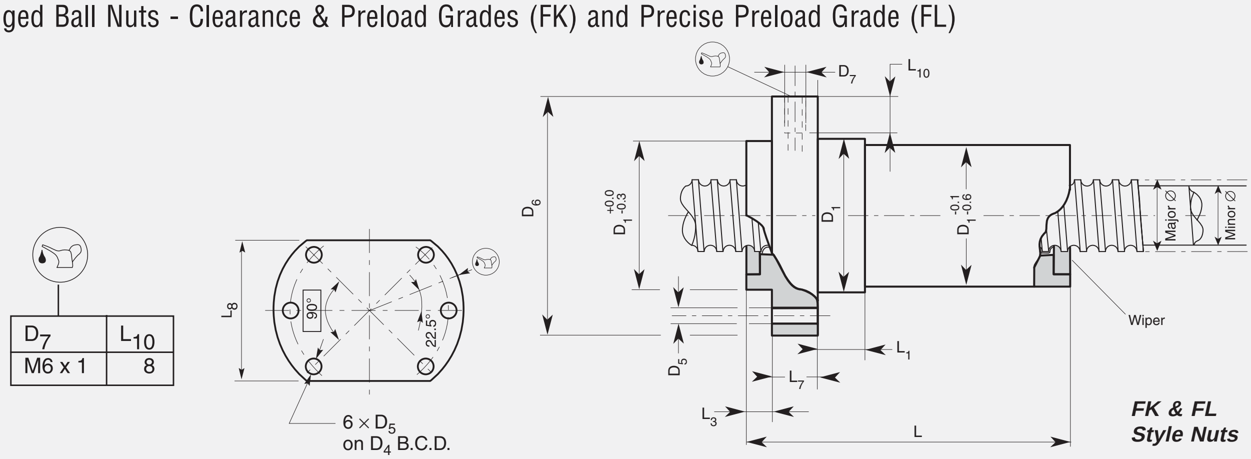
Threaded Ball Nuts - Clearance Preload Grade (ZG)



ZG Style Nut

Nom. Diam.	Lead	Nut Type	Nut Dimensions [in]										
d_0 [in.]	P_{h0} [in.]		D_1 h_{12}	D_{11}	D_{12}	D_{13} ±0.004	L ±0.04	L_{11} -0.02	L_{12} ±0.08	L_{13} ±0.08	Nut Weight [kg]	[lbm]	Ball ∅ (D_w) [in.]
0.625	0.200	ZG	1.26	M 30 x 1.5	M 6 x 1	0.157	2.26	0.65	0.41	0.87	0.22	0.49	0.138

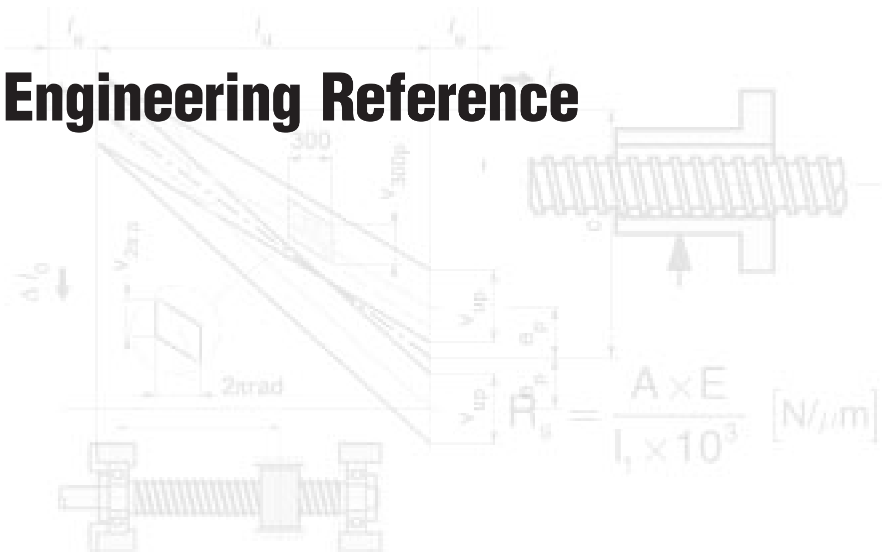
Flanged Ball Nuts - Clearance & Preload Grades (FK) and Precise Preload Grade (FL)



FK & FL Style Nuts

Nom. Diam.	Lead	Nut Type	Nut Dimensions [in]										
d_0 [in.]	P_{h0} [in.]		D_1 g_6	D_4	D_5	D_6 h_{12}	L ±0.04	L_1 +0.08	L_3 -0.02	L_7 h_{13}	L_8 h_{13}	Nut Weight [kg]	[lbm]	Ball ∅ (D_w) [in]
0.625	0.200	FK	1.10	1.50	0.22	1.89	1.91	0.39	0.22	0.39	1.57	0.25	0.55	0.138
0.625	0.200	FL	1.10	1.50	0.22	1.89	2.17	0.39	0.22	0.39	1.57	0.21	0.46	0.138

Engineering Reference



Efficiency & Torque

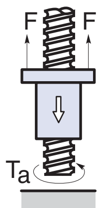
The ball screw assembly's performance in converting between linear motion and rotational torque is its efficiency, η. Efficiency depends primarily on geometrical data, though various operating influences can swing actual efficiency by ±5% from the calculated. As such, to account for operational influences such as speed, temperature, lubricant, etc., approximately 5% of the theoretical efficiency should be deducted.

Furthermore, if the ratio of load (F) to dynamic load rating (C_{am}) is below 0.5, then an additional reduction in relation to the load factor is to be applied (see table below for f_L).

The efficiency calculated on this basis applies for the ball screw including lubrication but without considering wipers or shaft support.

If an improvement in efficiency is required, please contact our engineering department.

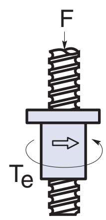
Efficiency: Rotary to Linear



The theoretical efficiency (η), when converting torque into linear motion is:

$$\eta = \frac{\tan\varphi}{\tan(\varphi + \rho")} \quad \text{with } \tan\varphi = \frac{P_{h0}}{d_0 \times \pi}$$

Efficiency: Linear to Rotary



The theoretical efficiency (η'), when converting linear motion into torque is:

$$\eta' = \frac{\tan(\varphi - \rho")}{\tan\ \varphi} \quad \text{with } \tan\varphi = \frac{P_{h0}}{d_0 \times \pi}$$

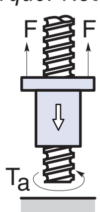
Practical Efficiency:

$$\eta_p = \eta \times .95 \times f_L$$

Parameters:

- $\rho"$ = friction angle (0.23° for P-class tolerances, 0.34° for T-class tolerances)
- φ = lead angle
- P_{h0}, d_0 = lead & diameter (see product specifications)
- F = axial load
- C_{am} = dynamic load rating
- T_a = drive torque
- T_e = output torque
- f_L = adjusted to load factor
- η, η' = theoretical efficiency

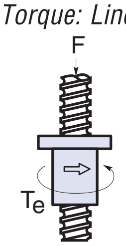
Torque: Rotary to Linear



When converting torque into linear motion, the necessary drive torque is:

$$T_a = \frac{F \times P_{h0}}{2 \times \pi \times \eta_p}$$

Torque: Linear to Rotary



When converting linear motion into torque, the resulting output torque is:

$$T_e = \frac{F \times P_{h0} \times \eta'_p}{2 \times \pi}$$

Load Adjustment Factors

$\frac{F}{C_{am}}$	**Adjustment to load factor (f_L)**
0.5	1.00
0.4	0.99
0.3	0.98
0.2	0.97
0.1	0.96

For approximate torque based on 90% efficiency:

$$T_a = 0.177 \times F \times P_{h0} \qquad T_e = .143 \times F \times P_{h0}$$

Example

Parameters:

40 x 10 mm screw, P3 class
F = 10 kN
C_{am} = 53.9 kN

Rotary to Linear Application

The lead angle, φ, is found:

$$\tan\varphi = \frac{10}{40 \times \pi} = 0.08$$

$$\varphi = 4.55°$$

P3 precision indicates friction angle of $\rho"$=0.23°
Thus, the theoretical efficiency is:

$$\eta = \frac{0.08}{\tan(4.55° + 0.23°)} = .96$$

The loading ratio is small, so a load adjustment factor is required:

$$\frac{F}{C_{am}} = \frac{10}{53.9} = 0.19$$

$$f_L \approx 0.97$$

Applying the load adjustment factor and 5% reduction gives practical efficiency of:

$$\eta_p = \eta \times .95 \times f_L$$

$$\eta_p = .96 \times .95 \times .97$$

$$\eta_p = .88 \pm 5\%$$

Torque required to drive the load is given by:

$$T_a = \frac{10{,}000\ [N] \times .010\ [m]}{2 \times \pi \times .88}$$

$$T_a = 18.1\ [Nm]$$

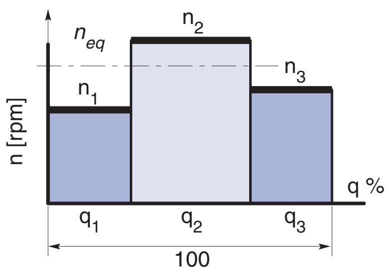
Functional Life

Life

The ball screw assembly's useful life will vary according to load and speed. Life is typically rated at 90% confidence, L_{10} (which represents time at which 90% of assemblies still perform).

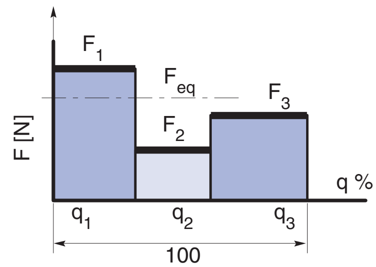
Functional life should be determined by approximating equivalent rotational speed and loading force over typical performance cycles.

Simple rotational speed profile



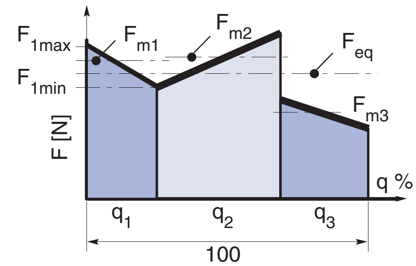
$$n_{eq} = \sum_{i=1}^{n} n_i \times \frac{q_i}{100} \quad [\text{min}^{-1}]$$

Simple loading profile (1)



$$F_{eq} = \left(\sum_{i=1}^{n} F_i^3 \times \frac{n_i}{n_{eq}} \times \frac{q_i}{100} \right)^{1/3} \quad [\text{N}]$$

Simple loading profile (2)



$$F_{eq} = \left(\sum_{i=1}^{n} F_{mi}^3 \times \frac{n_i}{n_{eq}} \times \frac{q_i}{100} \right)^{1/3} \quad [\text{N}]$$

Modified Life

$$L_{10} = \left[\frac{C_{am}}{F_{eq}} \right]^3 \times 10^6 \quad [\text{rev}]$$

$$L_{h10} = \frac{L_{10}}{n_{eq} \times 60} \quad [\text{hours}]$$

Parameters:

n_{eq} = equivalent rotational speed [rpm]

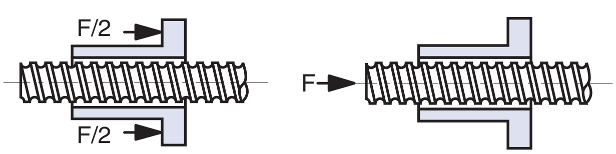
F_{eq} = equivalent load [N]

C_{am} = modified dynamic load rating [N] (see specification tables)

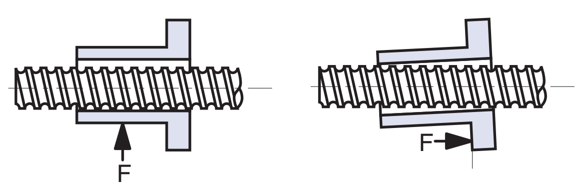
Nut Loading

Axial loading (on nut or screw) is optimal for performance and life.
For applications requiring radial loads, please contact us.

Axial Loading: optimal



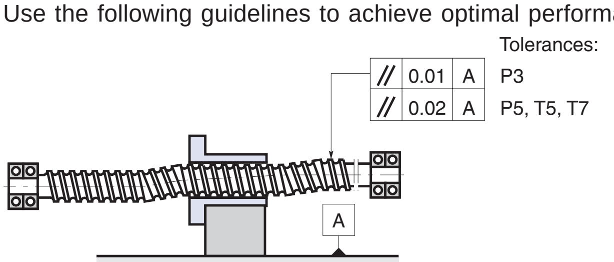
*Radial Loading: detrimental**

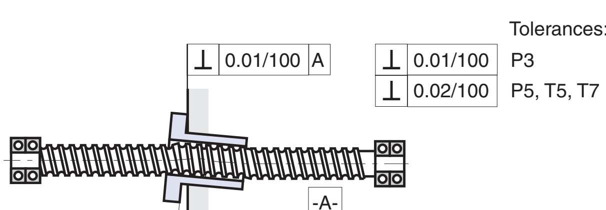


**Minimize radial loading to less than 5% of the axial load.*

Nut Mounting

Use the following guidelines to achieve optimal performance.

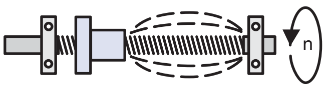




Speed Limitations

Critical Rotational Speed

Eccentricities in the screw will cause harmonic vibration at the critical rotational speed (n_{cr}). Vibration speed and magnitude are determined by shaft diameter, unsupported length, type of bearing support, position of the ball nut in the stroke, how the ball nut is mounted, the shaft or ball nut rpm, etc. (Shaft vibrations may also be caused by a bent screw or faulty installation alignment.) BS&A recommends a 20% safety factor below critical harmonic speed.



Critical harmonic speed:

$$n_{cr} = 1.2 \times 10^8 \times \frac{d}{l_{cr}^2} \quad [\text{rpm}]$$

Recommended maximum speed:

$$n_{crp} = 0.8 \times n_{cr} \times f_{cr} \quad [\text{rpm}]$$

Parameters:

$$d \approx \frac{d_0 + d_3}{2} \quad [\text{mm}]$$

$$d_3 \approx d_0 - D_w \quad [\text{mm}]$$

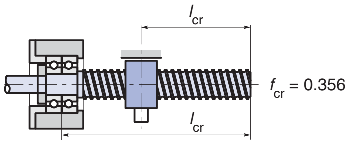
$$D_w = \text{Ball}\phi \quad [\text{mm}]$$

$$l_{cr} = \text{critical length} \quad [\text{mm}]$$

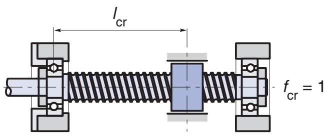
$$f_{cr} = \text{mounting condition speed adjustment factor}$$

Mounting Condition Effects

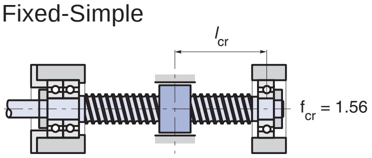
Fixed-Free



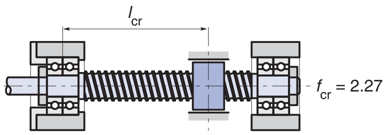
Simple-Simple



Fixed-Simple



Fixed-Fixed

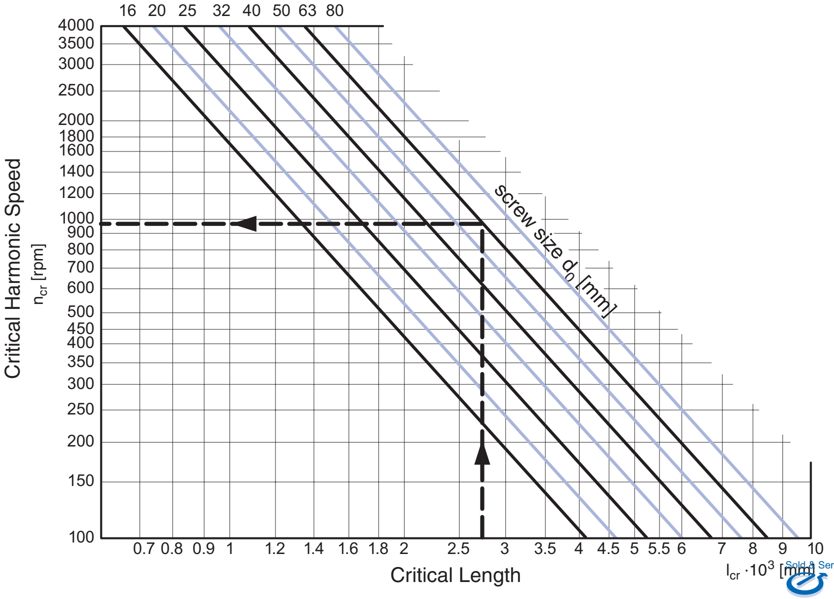


Maximum speed

A maximum rotational speed limit should be observed according to tolerance and shaft diameter regardless of critical speed limit compliance.

Tolerance class	Rotational speed limit [rpm]
P3, P5, T5	140,000/d_0 [mm]
T7	100,000/d_0 [mm]

Critical Harmonic Speed Chart



Example

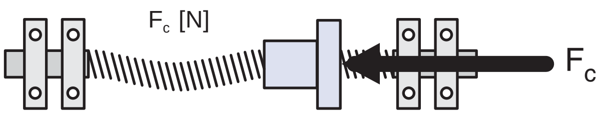
Parameters:
d_0 = 63 mm
l_{cr} = 2700 mm
Fixed-simple loading

Reading from chart, using length and screw size, gives critical rotational speed n_{cr} = 970 rpm. Fixed-simple mounting indicates speed adjustment factor of f_{cr} = 1.56. Thus, the recommended maximum speed is:

n_{crp} = 0.8 x 970 x 1.56

n_{crp} = 1210 rpm

Buckling



Compression loads (where force pushes on bearing and support) tend to cause the screw shaft to bend, requiring larger screw diameters than for comparably loaded tensile situations. Where possible, applications should be designed for tension loading (where force pulls on bearing and support.)

Critical buckling force:

$$F_c = \frac{1.017 \times 10^5 \times d^4}{l_c^{\,2}} \quad [N]$$

Recommended maximum force:

$$F_{cp} = 0.8 \times F_c \times f_c \quad [N]$$

Parameters:

$$d \approx \frac{d_0 + d_3}{2} \quad [mm]$$

$d_0 =$ nominal diameter $[mm]$

$d_3 \approx d_0 - D_w$ $[mm]$

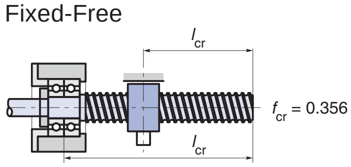
$D_w =$ Ballϕ $[mm]$
(see production specifications)

$l_c =$ stroke length $[mm]$

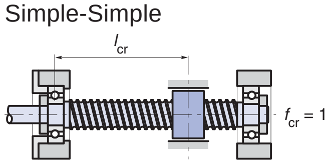
$f_c =$ mounting condition
load adjustment factor

Mounting Condition Effects

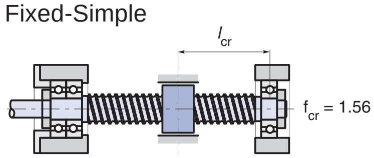
Fixed-Free



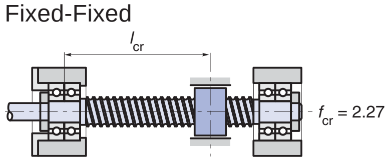
Simple-Simple



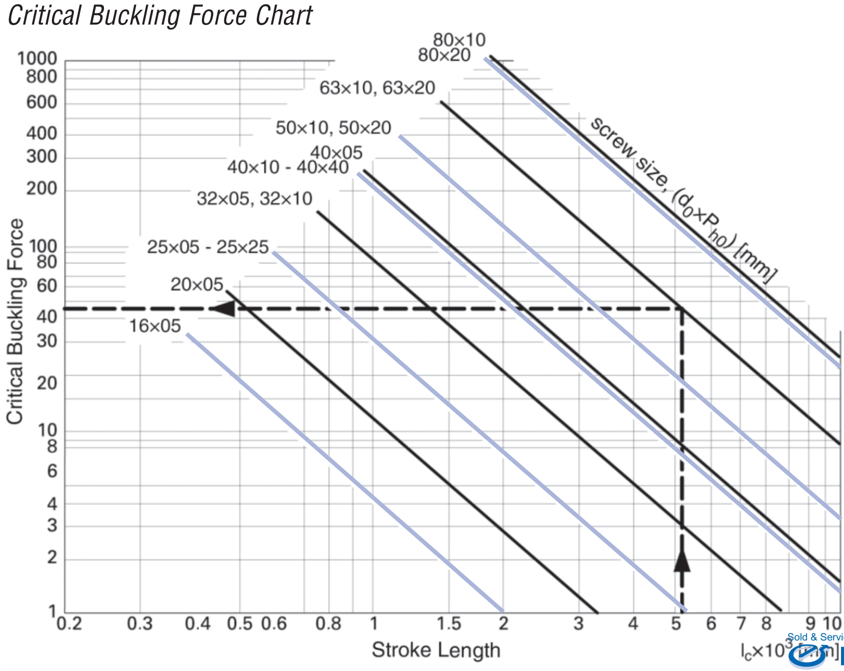
Fixed-Simple



Fixed-Fixed



Critical Buckling Force Chart



Example

Parameters:

d_0 = 63 mm, Ph_0 = 10 mm
l_c = 5200 mm
Fixed-simple loading

Reading from chart, using length and screw size, gives F_c = 45 kN. Fixed-simple loading indicates a mounting condition load adjustment factor of f_c = 2.0 (from above). Thus, the recommended maximum load is:
F_{cp} = 0.8 x 45 x 2
F_{cp} = 72 kN

Rigidity

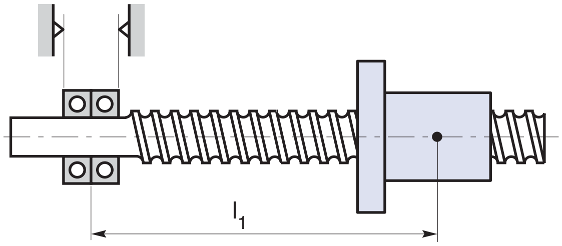
For most low-load applications, screw rigidity is not an essential design consideration, as screw deflection is very small compared with travel variation. For high precision, high load applications, however, deflection caused by loading may be significant. In these circumstances, precisely preloaded nuts should be used (series FL) to assure adequate system rigidity.

The total rigidity R_{tot} of the ball screw unit is determined by the rigidities of the screw shaft (R_s^{-1} see below) and of the nut unit (R_{nu}^{-1} see product specification tables). Overall rigidity (without bearing) is calculated as:

$$\frac{1}{R_{tot}} = \frac{1}{R_s} + \frac{1}{R_{nu}} \quad [N/\mu m]$$

Screw Shaft Rigidity

Rigid mounting at one end



$$R_s = \frac{A \times E}{l_1 \times 10^3} \quad [N/\mu m]$$

Parameters:

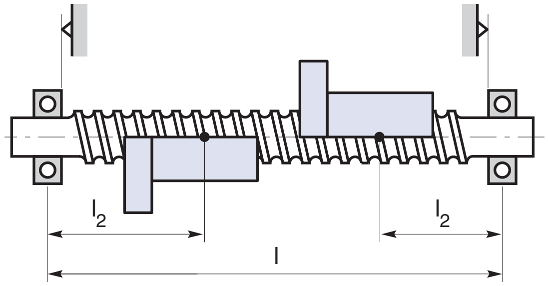
$E = 21 \times 10^4$ $[N/mm^2]$

l, l_1 $[mm]$

A = Cross sectional area of screw shaft (see below)

Screw Shaft Rigidity

Rigid mounting at both ends



$$R_s = \frac{A \times E}{l_2 \times 10^3} \times \frac{l}{l - l_2} \quad [N/\mu m]$$

$(R_s$ is minimum for $l_2 = 0.5 \times l)$

Parameters:

$E = 21 \times 10^4$ $[N/mm^2]$

l, l_2 $[mm]$

A = Cross sectional area of screw shaft (see below)

Screw shaft cross-sectional area

d_0 [mm]	16	20	25	32		40		50	63	80	
P_{h0} [mm]	5	5	5-25	5	10	5	10-40	10-20	10-20	10	20
A [mm^2]	162	263	428	723	685	1155	1075	1705	2823	4650	4412

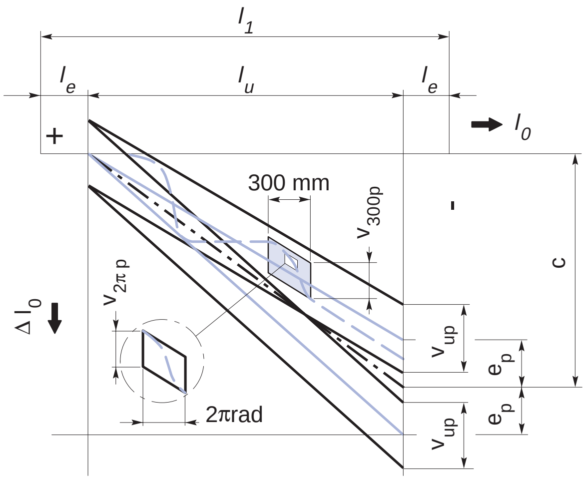
Lead Accuracy

Permissible Travel Deviations

Lead accuracy is specified by a tolerance class. The primary difference between the two tolerance class types offered is the way they control cumulative lead error. P class ball screws are more precise over long lengths than T class screws. Variation information for FineLine Ball Screws is given here.

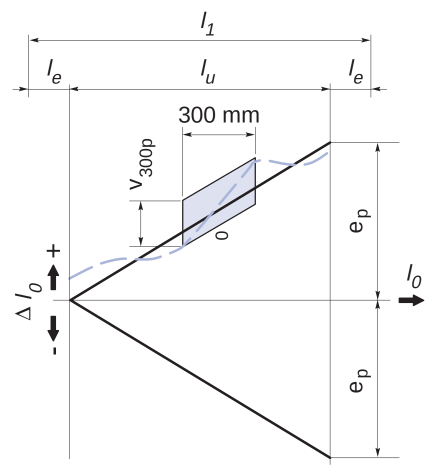
P - Positioning Class Ball Screws

Maximum error over useful length = $e_p + \frac{1}{2} v_{up} + C$



T - Transport Class Ball Screws

Maximum error over useful length = e_p



l_1 = Axial thread length l_u = Usable travel l_e = Excess travel l_0 = Nominal travel Δl_0 = Travel deviation

Parameters

		Accuracy Class		
		P3	P5	T5, T7
v_{300p}	Permissible travel variation within 300 mm travel	Table 1	Table 1	Table 1
$v_{2\pi p}$	Permissible travel variation within 2π travel	Table 1	Table 1	-
c	Compensation for temperature	-	-	-
e_p	Tolerance on useful travel l_u	Table 3	Table 3	$2 \times \frac{l_u}{300} \times V_{300p}$
v_{up}	Permissible travel variation within useful travel l_u	Table 3	Table 3	-

Permissible travel variation (Table 1)

Tolerance Class	3	5	7
$V_{300\,p}$ [µm]	12	23	52
$V_{2\pi\,p}$ [µm]	6	8	-

Excess travel (Table 2)

Nominal lead	P_{h0} [mm]	≤ 5	≤ 10	≤ 20	> 20
Excess travel	l_e [mm]	20	40	60	80

Permissible cumulative travel variation over long distances (Table 3)

		l_u [mm]	>		315	400	500	630	800	1000	1250	1600	2000	2500	3150	4000	5000
			≤	315	400	500	630	800	1000	1250	1600	2000	2500	3150	4000	5000	6300
Tolerance Class	P3	e_p [µm]		12	13	15	16	18	21	24	29	35	41	50	62	76	-
		v_{up} [µm]		12	12	13	14	16	17	19	22	25	29	34	41	49	-
	P5	e_p [µm]		23	25	27	30	35	40	46	54	65	77	93	115	140	170
		v_{up} [µm]		23	25	26	29	31	35	39	44	51	59	69	82	99	119

Lubrication & Materials

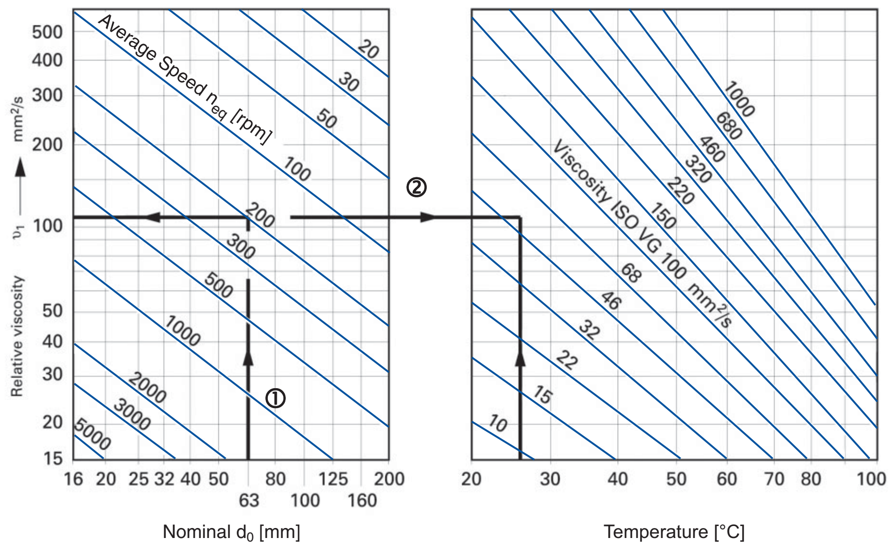
Correct lubrication of ball bearing screws is not only a must for achieving the calculated lifetime, but also is important for quiet running, for reducing temperature rise during operation, and for reducing the no-load torque. If the customer does not prescribe anything else, the final acceptance test at the factory will be performed with an oil ISO VG100. Other acceptable viscosities include ISO VG68, VG150 and VG200.

Oil lubrication

Generally, the use of CL oils or the use of alloyed CLP oils with EP additives increase the corrosion prevention and the resistance to aging. The correct viscosity depends on the circumference, speed (diameter and revolution), and the ambient and/or the anticipated operating temperature.

The precise amount of oil required per ball circle depends on the revolving speed. Amounts of approximately 0.3 to 0.5 cm^3/h are adequate when using oil, or roughly 10% of this amount for greases. For submerged lubrication in a horizontal installation, oil levels at the center of the lowest ball are adequate.

Oil Viscosity Determination Chart



Example

Parameters:

Average speed, n_{eq} = 200 rpm
Operating temperature, t = 25°C
Diameter, d_0 = 63 mm

① For the nominal diameter 63 mm and n_{eq} = 200 rpm the left part of the diagram indicates a viscosity υ_1 of 110 mm^2/s.

② Projection of this value into the right diagram, with a temperature of 25°C results in the intersection point between ISO VG46 and ISO VG68. To guarantee a sufficient lubrication film at all working conditions, the higher value should be chosen, in this case ISO VG68, (at long operating times, possibly even higher viscosities could be used).

Grease lubrication

Ball bearing screws can also be lubricated with grease, reducing time between required lubrications.

In operation, a small quantity of grease escapes from the nut and remains on the screw with each stroke (even with the best wipers), causing the grease supply to decrease during operation. To achieve calculated unit lifetime, L_{10}, it is therefore necessary either to create a lubrication time table or create a central lubrication installation system.

For manual relubrication an average value of 700 operating hours can be assumed. This indication varies largely as a function of the machine construction and the application. The grease quantity has to be defined so that the cavities are approximately half full. Unnecessary temperature rise of the ball bearing screw by overgreasing is to be avoided by making sure that consumed grease or excess grease can escape.

Greases are divided into NLGI classes according to DIN 51818. Normally for ball bearing screws, water resistant greases of class K2K20 (DIN 51825) have to be used (operating temperature -20°C to +120°C). In special cases greases K1K-20 (at very high number of revolutions) and/or KP2K-20 (at high load and/or low speed) are also possible.

Materials

Our typical materials for components are shown below. Additional heat or surface treatments are available upon request including chrome plating (Armaloy).

Part	Material	Heat Treatment
Screw shaft	~ Cf 53 N	Induction hardened
Nut	19 Mn Cr 5	Carburized
Wiper	Nylon	
Ball	100 Cr 6	62 ± 2 HRC

Please contact us for any additional requirements.

Glossary

Accuracy A measure of how closely a motion system will approach a command position. Perfect accuracy, for example, means advancing a ball nut exactly the same amount every time from a specific point on a screw will always require the theoretically predicated number of revolutions.

Backdrive Application of a force on a ball nut to cause rotation of the screw shaft; in essence, converting linear to rotary motion.

Backlash Free axial motion that is measured in a ball screw system.

Ball Circle Diameter The distance between the centerlines of two exactly opposing recirculating balls when they are in contact with the screw. The basic point of reference used by BS&A when dealing with ball screws.

Compression Load A force that would tend to squeeze the screw in an axial direction.

Critical Speed The condition where the rotary speed of the assembly sets up harmonic vibrations. These vibrations are the result of shaft diameter, unsupported length, type of bearing support, ball nut mounting method, or the shaft or ball nut rpm.

Cycle The complete load-carrying extension and retraction of the screw or nut. Each cycle consists of two strokes (one forward and one back to the point of origin).

Dynamic (Operating) Load The axial force which the ball screw will experience during movement.

Efficiency Expressed as a percentage, the ability of a ball screw assembly to convert torque to thrust with minimal mechanical loss.

End Fixity The bearing configurations that are used to support the ends of a ball screw assembly.

Lead The axial advance of the ball nut per revolution of the screw.

Linear Expansion Ball screw and spline inner races have a coefficient of linear expansion of 0.0000065 for each degree of change (F) and for each inch of race length.

Lubrication To provide the maximum useful life, ball screws require lubrication. In general, standard ball bearing lubrication practices are acceptable.

Off-Center Load A load that tends to create misalignment between the ball nut and screw shaft, which causes rotational binding and shortened operational life.

Operating Loads The normal operating force which the ball screw will experience is considered the operating load. Contact BS&A's application engineering for applications subject to widely fluctuating loads or to optimize design.

Preload A method of loading one set of bearing balls in opposition to each other to eliminate all axial freedom. Preloading increases system stiffness and eliminates backlash.

Repeatability The degree to which a system will return to the same command position over time. Axial backlash degrades repeatability by introducing uncertainty into the absolute nut position.

Root Diameter The diameter of the screw shaft as measured at the bottom of the ball track.

Screw Diameter (land diameter) The outside diameter of the screw shaft.

Screw Starts The number of individual threads on a screw shaft.

Side Load A radial force that significantly reduces rated life and can potentially lead to premature failure.

Static (Maximum) Load The maximum force that can be resisted without causing damage to the screw component with the system at rest.

Stiffness A ratio of load versus deflection of a component or of a total system.

Straightness Radial variation from a theoretically perfect cylinder of the same diameter.

Stroke The maximum length of travel required for the nut.

Temperature (operating) With suitable lubricants, ball screws will operate with a minimum loss of efficiency between temperatures of -65° to +300°F (-53° to +149°C). Contact BS&A for extreme temperatures.

Tension Load A force in a direction that would tend to stretch the screw.

Torque The force required to drive a ball screw in converting rotary to linear motion.

Travel and Travel Rate The distance a ball nut moves relative to the screw shaft. Travel rate is the distance traveled in a specific time period.

Application Requirements

BS&A
3616 Snell Avenue
San Jose, CA 95136-1305
www.ballscrews.com
email: sales@bsa-fineline.com
Toll-free: 1-800-966-7231
Fax: 1-408-629-2620

Contact BS&A for application and ordering assistance.

Company: ______________________________

____

____

Contact:

Technical: ____________________ Phone: ____________________

Fax: ____________________ Email: ____________________

Purchasing: ____________________ Phone: ____________________

Fax: ____________________ Email: ____________________

Application: ______________________________

____

☐ **New application**

☐ **Existing application**

Parameters:

Nominal diameter d_0 ____________ Lead ____________ P_{h0} ☐ in ☐ mm

Lead direction ☐ right ☐ left

Maximum travel deviation within 300 mm (12 in) ____________ ☐ 1/10000 in ☐ µm

Total length ____________ [mm] Quantity ____________ per year

Load ratings:

Load: ☐ lbf or ☐ N	Speed: rpm	Duty Cycle: %
F_1 = ____________	n_1 ____________	q_1 ____________
F_2 = ____________	n_2 ____________	q_2 ____________
F_3 = ____________	n_3 ____________	q_3 ____________

Max. static load ______________________________ ☐ lbf ☐ N

Life required ____________ (working hours) ____________ (10^6 Revolutions)

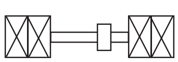
Mechanical:

Mounting ☐ Horizontal ☐ Vertical ☐ Diagonal

Driven part ☐ Screw ☐ Nut

Mounting configuration

Fixed-Fixed



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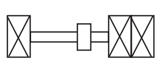
Simple-Fixed



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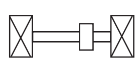
Simple-Simple



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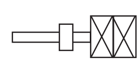
Free-Fixed



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FineLine **Ball Screws**

Manufactured using BS&A's
PSF Technology™

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