



# Miniature Metric BALL SCREW Assemblies

Linear Motion Solutions



Configure Online at  
[pbclinear.com](http://pbclinear.com)  
+1.800.962.8979

Miniature ball screw assemblies from PBC Linear have a range of leads with small screw diameters for high precision linear motion. Our ball screws are precision-rolled to achieve lead accuracy and consistency over the full length of the screw, making them a critical asset to laboratory machines, medical devices, and mechatronic applications.

Ball screws from PBC Linear are manufactured in America, avoiding the long lead times associated with overseas shipping.

## Available Sizes

• 6 metric sizes, measured in diameters x leads:

6 x 1			
6 x 2			
8 x 1			
8 x 2			
8 x 2.5	Ø6 mm	Ø8 mm	Ø10 mm
10 x 2			

- 1050 steel ball screws
- Standard and special machined journals available
- End support blocks and bearings available
- Grade 5, 7, or 10 accuracy available  
Contact an Application Engineer for ordering a specific grade at [application.engineering@pbclinear.com](mailto:application.engineering@pbclinear.com).

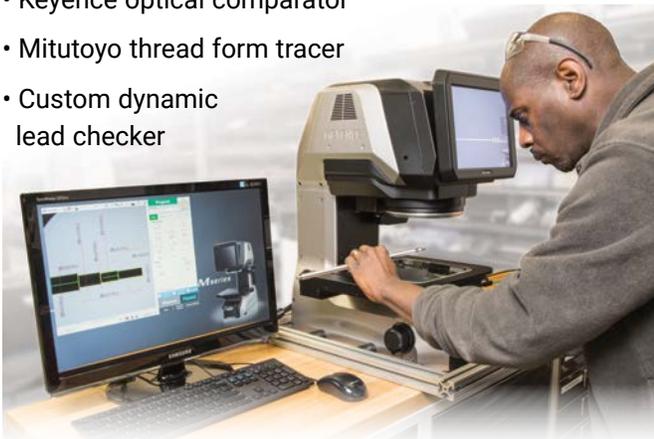


## State of the Art Metrology & Inspection

Our commitment to thorough testing is applied to our line of ball screw assemblies.

### Metrology Devices include:

- Keyence optical comparator
- Mitutoyo thread form tracer
- Custom dynamic lead checker



## Compact Nut

Our compact nut designs utilize internal returns to minimize the nut size and provide quiet motion.



### Standard Features:

- Flanged and cylindrical nut configurations
- Maximum of 0.05 mm backlash
- 100Cr6 steel nut bodies
- High axial load capacities

### Optional Features:

- Contact a PBC Linear Application Engineer about reduced backlash options

# Ball Screw Design Considerations

## Wipers & Contamination Protection

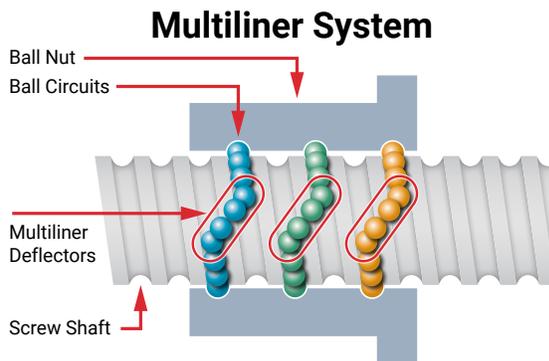
Wipers are located at each end of the nut to help prevent the ingress of debris and particulates that could damage the internal balls and affect the ball screw and nut performance.



The wipers are designed to provide tight clearances that maximize contamination protection without adding drag or increased friction to the assembly.

## Internal Ball Screw Return System

Ball screw nuts use an internal ball return that guides each turn of balls back to the same threads creating ball circuits within the nuts.



## Lubrication

Nuts and screws are shipped with only a light anti-rust protective coating applied. This anti-rust coating should be removed with a clean solvent wash and then a lubricant applied that is specific to your application and maintenance preferences.

Common, general-use lubricants would be a lithium based NLGI 2 grease with an EP additive (Example: Mobil Mobilux EP 2) or an oil such as Mobil DTE heavy medium oil.

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# Miniature Ball Screw Applications

## Defense

Ball screws meet the required precision and accuracy for various controls and guidance systems. Light weight and compact, ball screws are ideal for tight spaces and provide predictable reliability in critical applications.



## Medical

High load capacity in a small footprint (load density) is a requirement for many medical applications. Ball screws are ideal for medical applications where clean, quiet and smooth operation is critical.



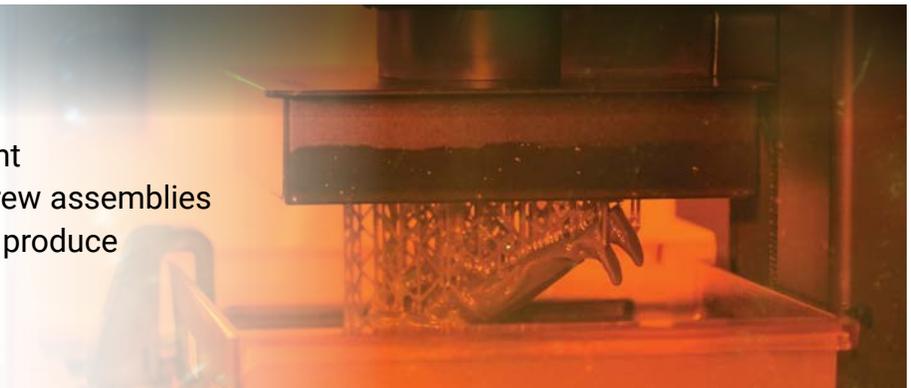
## Lab Automation

Testing and automation equipment requires high performance components capable of accurate and repeatable positioning.



## 3D Printing

Premium 3D printing equipment requires high accuracy ball screw assemblies built with minimal backlash to produce repeatable quality parts.



# American Made

## USA Made\* & Tested



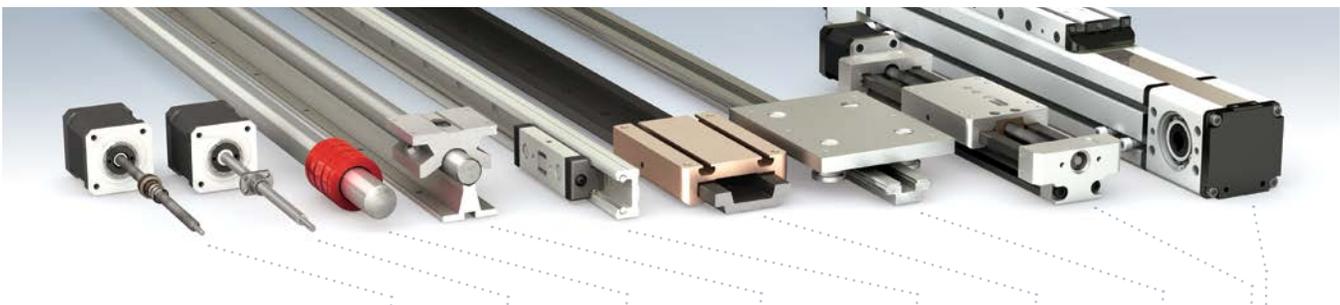
Our ball screw production process offers shorter lead times, avoiding costly downtimes and delays getting to market! Standard ball screws and nuts ship assembled together, but can be ordered separately.

## Machined End Customization



Contact PBC Linear about custom machining options available at [sales@pbclinear.com](mailto:sales@pbclinear.com) or call +1.815.389.5600.

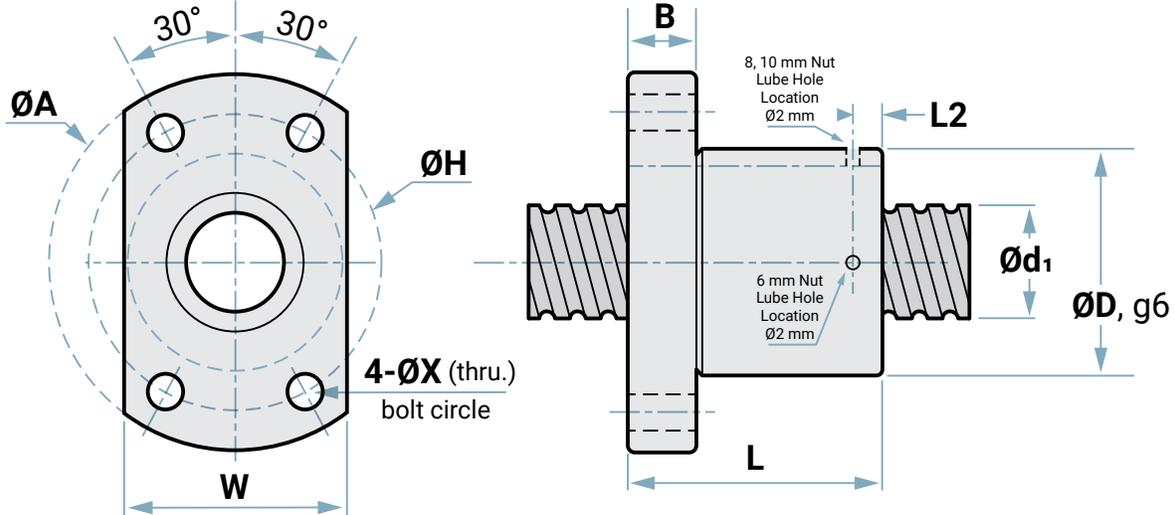
## PBC Linear has a Wide Range of Linear Solutions to Fit Your Application



	Lead Screw	Ball Screw	Simplicity Bearings	Roller Pillow Block	Cam Roller	Glide Surface	Integral-V	Mechatronics Systems
Inexpensive	●	●	●	●	●	●	●	●
Low Maintenance	●	●	●	●		●		●
Compact Size	●	●				●		●
Low Noise	●		●					●
Multiple Configurations	●	●	●	●	●	●	●	●
Washdown Applications	●		●			●		●
Custom Design Support	●	●	●	●	●	●	●	●
Moderate to High Speed	●	●	●	●	●	●	●	●
Vacuum & Cleanroom Applications	●	●**	●			●		●
Food Processing	●	●**	●	●		●		
Ease of Installation	●	●			●		●	●

\* PBC Linear ball screws are made in America using both domestic and foreign material sources.  
 \*\* Only with special lubricants

# Flange Ball Screw and Nut Sets



## Dimensions

Dia. x Lead mm	ØD mm	ØA mm	B mm	L mm	L2 mm	ØH mm	W mm	ØX mm
6 x 1	12	24	3.5	15	2.4	18	16	3.4
6 x 2	12	24	4.0	17	2.4	18	16	3.4
8 x 1	14	27	4.0	16	3.2	21	18	3.4
8 x 2	14	27	4.0	16	2.1	21	18	3.4
8 x 2.5	16	29	4.0	26	4.8	23	20	3.4
10 x 2	18	35	5.0	28	5.3	27	22	4.5

## Load Ratings

Dia. x Lead mm	Static C <sub>0a</sub> (kN)	Dynamic C <sub>a</sub> (kN)
6 x 1	0.97	0.74
6 x 2	1.14	1.05
8 x 1	1.34	0.90
8 x 2	1.70	1.32
8 x 2.5	1.70	1.32
10 x 2	2.18	1.49

## Geometry

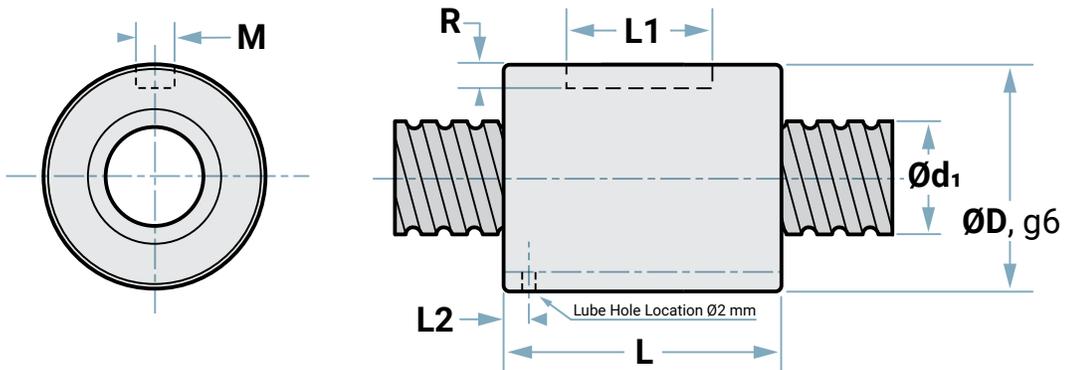
Dia. x Lead mm	Screw OD d <sub>1</sub> (mm)	Screw Root Ø d <sub>2</sub> (mm)	Lead P <sub>h</sub> (mm)	Ball Diameter D <sub>w</sub> (mm)	Starts x Circuits
6 x 1	5.95	5.37	1.0	0.8	1 x 3
6 x 2	5.95	5.13	2.0	1.2	1 x 3
8 x 1	7.95	7.29	1.0	0.8	1 x 4
8 x 2	7.95	7.08	2.0	1.2	1 x 3
8 x 2.5	7.95	7.07	2.5	1.2	1 x 3
10 x 2	9.95	9.09	2.0	1.2	1 x 3

**Note:** The static and dynamic load ratings of PBC Linear balls crews were determined by the ISO 3408 standard calculations.

The dynamic load rating, **C<sub>a</sub>**, is the load at which 90% of properly lubricated identical ball screws will reach 1 x 10<sup>6</sup> revolutions.

The static load rating, **C<sub>0a</sub>**, is an axial static load which will produce a permanent deformation at contact points of the steel balls to ball grooves equal to 0.01% of the ball diameter.

# Cylindrical Ball Screw and Nut Sets



## Dimensions

Dia. x Lead mm	ØD mm	L mm	L1 mm	L2 mm	M x R (P9) mm
6 x 1	12	15	8	2.4	2 x 1.2
6 x 2	12	17	8	2.4	2 x 1.2
8 x 1	14	16	8	3.4	2 x 1.2
8 x 2	14	16	8	2.1	2 x 1.2
8 x 2.5	16	26	10	4.8	3 x 2.0
10 x 2	18	28	10	5.3	3 x 1.2

## Load Ratings

Dia. x Lead mm	Static C <sub>0a</sub> (kN)	Dynamic C <sub>a</sub> (kN)
6 x 1	0.97	0.74
6 x 2	1.14	1.05
8 x 1	1.34	0.90
8 x 2	1.70	1.32
8 x 2.5	1.70	1.32
10 x 2	2.18	1.49

## Geometry

Dia. x Lead mm	Screw OD d <sub>1</sub> (mm)	Screw Root Ø d <sub>2</sub> (mm)	Lead P <sub>h</sub> (mm)	Ball Diameter D <sub>w</sub> (mm)	Starts x Circuits
6 x 1	5.95	5.37	1.0	0.8	1 x 3
6 x 2	5.95	5.13	2.0	1.2	1 x 3
8 x 1	7.95	7.29	1.0	0.8	1 x 4
8 x 2	7.95	7.08	2.0	1.2	1 x 3
8 x 2.5	7.95	7.07	2.5	1.2	1 x 3
10 x 2	9.95	9.09	2.0	1.2	1 x 3

**Note:** The static and dynamic load ratings of PBC Linear balls crews were determined by the ISO 3408 standard calculations.

The dynamic load rating, **C<sub>a</sub>**, is the load at which 90% of properly lubricated identical ball screws will reach 1 x 10<sup>6</sup> revolutions.

The static load rating, **C<sub>0a</sub>**, is an axial static load which will produce a permanent deformation at contact points of the steel balls to ball grooves equal to 0.01% of the ball diameter.

# Part Number Configurator

Type	Thread Dir.	Diameter and Lead	Accuracy Class	Screw Type	Overall Screw Length	Nut	Nut Fit	Left End	Right End	Encoder Option	
<b>BS</b>	<b>R</b>	<b>0000A</b>	<b>TX</b>	<b>R</b>	<b>0000</b>	<b>L</b>	<b>S</b>	<b>N</b>	<b>000</b>	<b>AFA</b>	<b>E</b>

**Type**  
BS - Ball Screw

**Thread Direction**  
R - Right Hand Thread

**Diameter and Lead**  
**0601A** - 6 mm dia., 1 mm lead  
**0602A** - 6 mm dia., 2 mm lead  
**0801A** - 8 mm dia., 1 mm lead  
**0802A** - 8 mm dia., 2 mm lead  
**08025** - 8 mm dia., 2.5 mm lead  
**1002A** - 10 mm dia., 2 mm lead

**Accuracy Grade\***  
**TX** - Grade 10, Transport  
**T7** - Grade 7, Transport  
**T5** - Grade 5, Transport  
**P5** - Grade 5, Positioning

**Type of Screw**  
R - Rolled

**Screw Length**  
Metric - 0000 mm

**Type of Nut**  
**L** - Flanged on Left  
**R** - Flanged on Right  
**C** - Cylindrical

**Backlash**  
**S** - Standard (0.05 mm MAX)

**Not Used**  
N - Unused

**Left End Only**  
**080** - NEMA 8 Motor (16 mm)  
(Requires a 6 mm screw)  
Not available with encoder ready option.  
**111** - NEMA 11 Motor (23 mm)  
(Requires a 6 mm screw)  
**140** - NEMA 14 Motor (31 mm)  
(Requires a 6 mm, 8 mm, or 10 mm screw)  
**171** - NEMA 17 Motor (43 mm), Single Stack  
(Requires a 6 mm, 8 mm, or 10 mm screw)  
**172** - NEMA 17 Motor (43 mm), Double Stack  
(Requires a 10 mm screw)  
**231** - NEMA 23 Motor (56 mm), Single Stack  
(Requires a 10 mm screw)  
**232** - NEMA 23 Motor (56 mm), Double Stack  
(Requires a 10 mm screw)  
**23P** - NEMA 23 Motor (56 mm), Power Plus  
(Requires a 10 mm screw)  
**NNN** - None

**Encoder**  
**E** - Encoder Ready  
**N** - No Option

**Left and/or Right Ends**  
**AFN** - Float Journal  
**AFA** - Float Journal and Bearing Block-Axial Mount  
**AFB** - Float Journal and Bearing Block-Base Mount  
**ALN** - Fixed Journal  
**ALA** - Fixed Journal and Bearing Block-Axial Mount  
**ALB** - Fixed Journal and Bearing Block-Base Mount  
**BFN** - Float Journal with Drive Extension  
**BFA** - Float Journal with Drive Extension and Bearing Block-Axial Mount  
**BFB** - Float Journal with Drive Extension and Bearing Block-Base Mount  
**BLN** - Fixed Journal w/Drive Extension  
**BLA** - Fixed Journal w/Drive Extension and Bearing Block-Axial Mount  
**BLB** - Fixed Journal w/Drive Extension and Bearing Block-Base Mount  
**CFN** - Float Journal w/Drive Extension-w/Flat  
**CFA** - Float Journal w/Drive Extension-w/Flat and Bearing Block-Axial Mount  
**CFB** - Float Journal w/Drive Extension-w/Flat and Bearing Block-Base Mount  
**CLN** - Fixed Journal w/Drive Extension-w/Flat  
**CLA** - Fixed Journal w/Drive Extension-w/Flat and Bearing Block-Axial Mount  
**CLB** - Fixed Journal w/Drive Extension-w/Flat and Bearing Block-Base Mount  
**NNN** - None

\* **Reference ISO 3408-3** for more details about ball screw grades see page 15 for Permissible Deviations for Ball Screw Grades

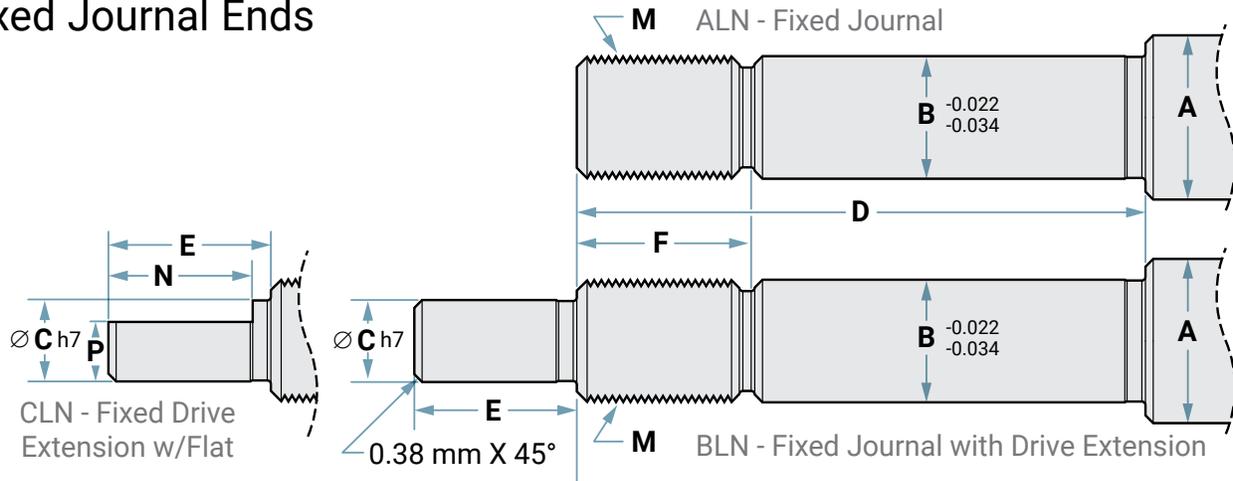
**Note:** Floating option bearing blocks not available for 6 mm ball screws  
 Standard Ball Screw assemblies come assembled. Also available as unassembled.  
 Journal tolerances correspond to the ball screw grade accuracy.  
 Contact an Application Engineer for special journals

## Sample Part Numbers

Left	Right	Left	Right	Left	Right
BSR1002ATXR-0450-RSN-AFN-AFN-N		BSR0601AT7R-0300-CSN-CFN-BFB-N		BSR0802AP5R-0500-LSN-171-AFN-E	

# Machined Ends for Bearing Blocks

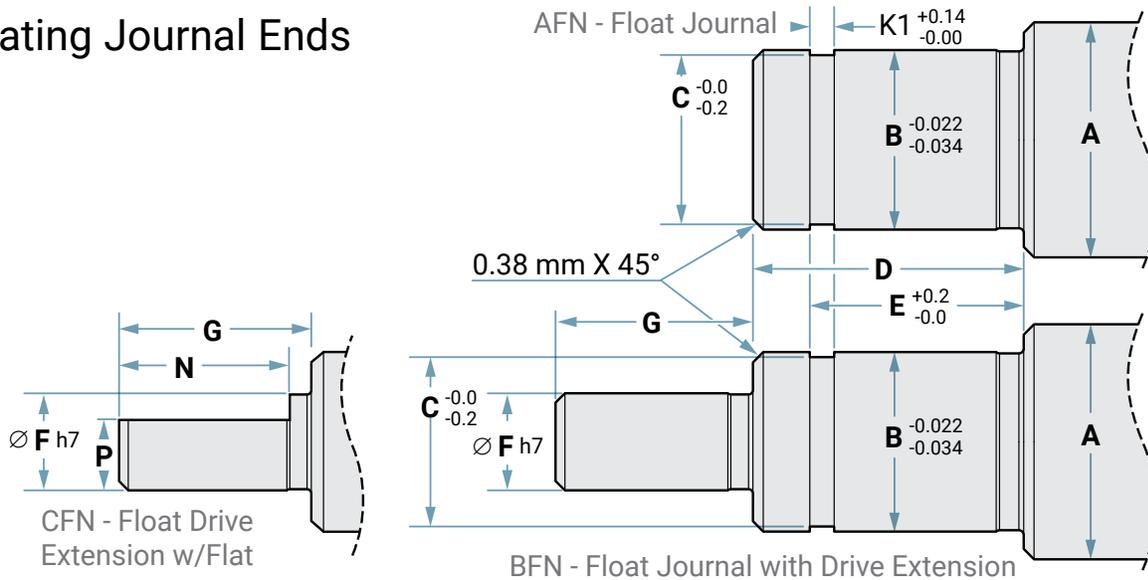
## Fixed Journal Ends



### Dimensions

End Block	A mm	B mm	C mm	D mm	E mm	F mm	M	N mm	P mm
EK05 FK05	6	5	4	23	6	7	M5 x 0.50-6g	5	3.5
EK06 FK06	8	6	4	28	8	8	M6 x 0.75-6g	7	3.5
EK08 FK08	10	8	6	32	9	10	M8 x 1.00-6g	8	5.5

## Floating Journal Ends



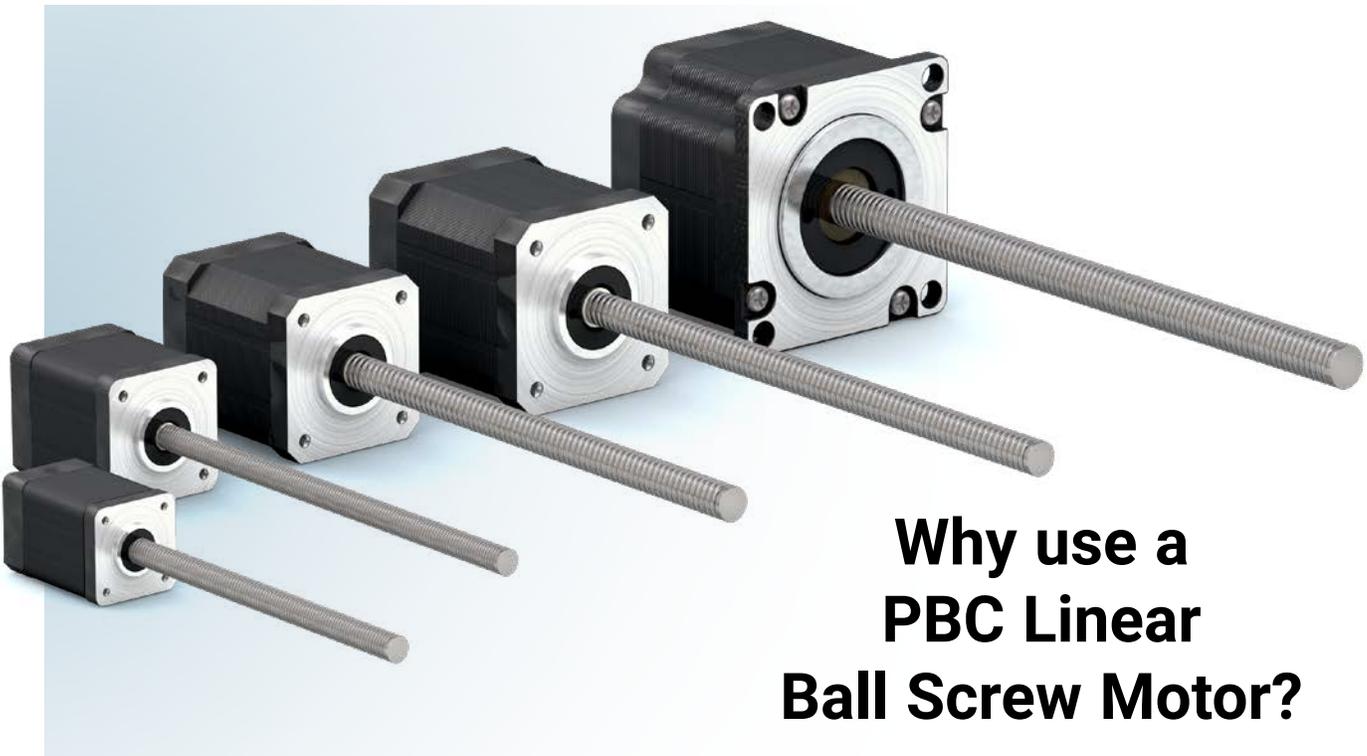
### Dimensions

End Block	A mm	B mm	C mm	D mm	E mm	K1 mm	F mm	G mm	N mm	P mm
EF06* EF08 FF06	8	6	5.7	9	6.8	0.8	4	8	7	3.5
EF10 FF10	10	8	7.6	10	7.9	0.9	6	9	9	5.5

\*Optional smaller size end block option, see page 11 for sizing of EF06. Must specify EF06 over standard EF08 end block if chosen.

**Note:** Contact Application Engineer for special journals.

# Ball Screw Motors



## Why use a PBC Linear Ball Screw Motor?

### Cost Reduction

Fusing the motor and screw together eliminates the need for a motor mount and coupling. This also reduces setup time.

### Improved Performance

Factor alignment of the motor and screw means direct out of the box precision.

### Variety

Many choices of nut styles and options, to cover almost many application needs.

### Support & Customs

Not finding what you need or need a custom solution? PBC Linear has your engineering support covered!  
Phone: 1-888-389-6266 or  
[pbclinear.com](mailto:pbclinear.com)

PBC Linear ball screw motor products are designed based on the know-how technology of hybrid step motors, ball screw and nuts. The NEMA Series ball screw motors provide high torque, high precision, and high efficiency to fit the application needs of designers. The combination of ball screw motor styles, sizes, ball-screws and nuts, gives the freedom to use motors of different form factors to exactly fit in the application. And, it provides excellent performance with any drive and power supply.

- Five frame Sizes: 8, 11, 14, 17, 23
- Multiple motor lengths and special PowerPlus motors, provide more than 10 different motor sizes
- Integrate any ball screw from PBC Linear
- Each frame size motor offers different standard ball screws
- Each frame size motor has different selections of nuts

PBC Linear has committed to product innovation design and technical improvement, with excellent product quality, application technology, fast and flexible services, which provide customers with high level motion control solutions.

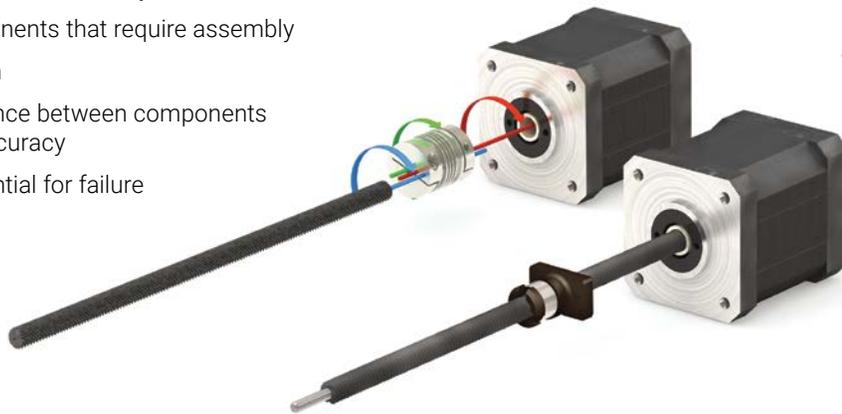
# Hybrid Linear Ball Screw Actuator Selection Chart

Motor Frame	Screw Sizes		
	6 mm	8 mm	10 mm
NEMA 8	●		
NEMA 11	●		
NEMA 14	●	●	●
NEMA 17, Single Stack	●	●	●
NEMA 17, Double Stack		●	●
NEMA 23, Single Stack			●
NEMA 23, Double Stack			●
NEMA 23, Power Plus			●

## Ball Screw to Motor Connection Method Matters

### Traditional Motor/Screw Setup

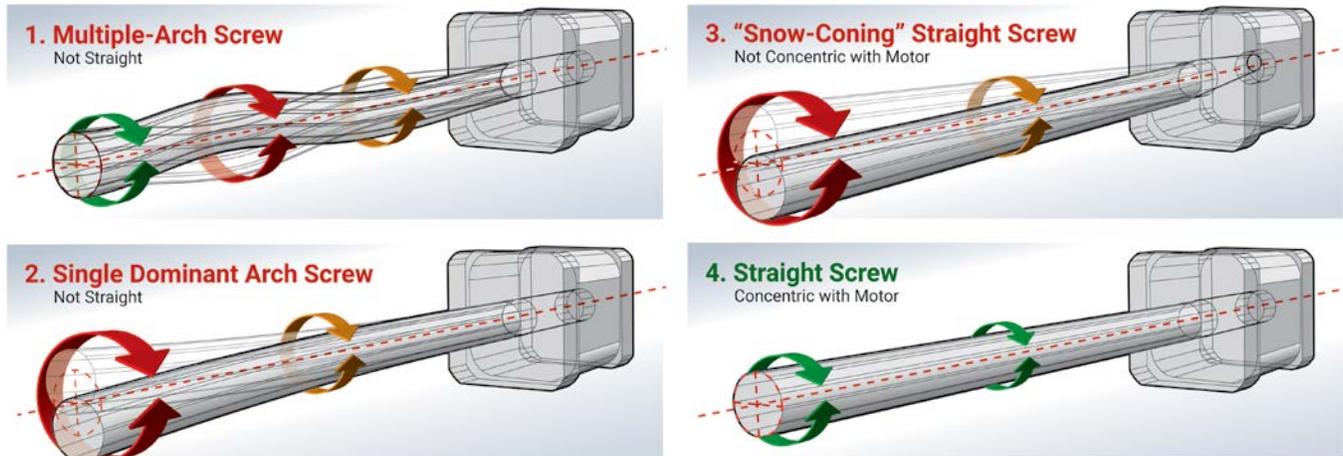
- Multiple components that require assembly
- Difficult to align
- Play and tolerance between components result in lost accuracy
- Increased potential for failure
- Higher costs



### Integrated Hybrid Linear Actuator Setup

- Ball screw aligned and fixed directly with motor
- Fewer components
- Greater accuracy
- More reliable
- Higher rigidity
- Greater value

## Common Ball Screw Straightness Issues



PBC Linear utilizes an automated straightening process and holds tight TIR tolerances to eliminate common ball screw runout and straightness issues

# NEMA 8 Series



Phases.....	2	Approvals .....	RoHS
Steps/Revolution.....	200	Operating Temp. ....	-20°C–+50°C
Step Accuracy.....	±5%	Insulation Class .....	B (130°C)
IP Rating .....	40	Insulation Resistance.....	100 MΩ

## Step Motor - 4 Lead Bi-Polar

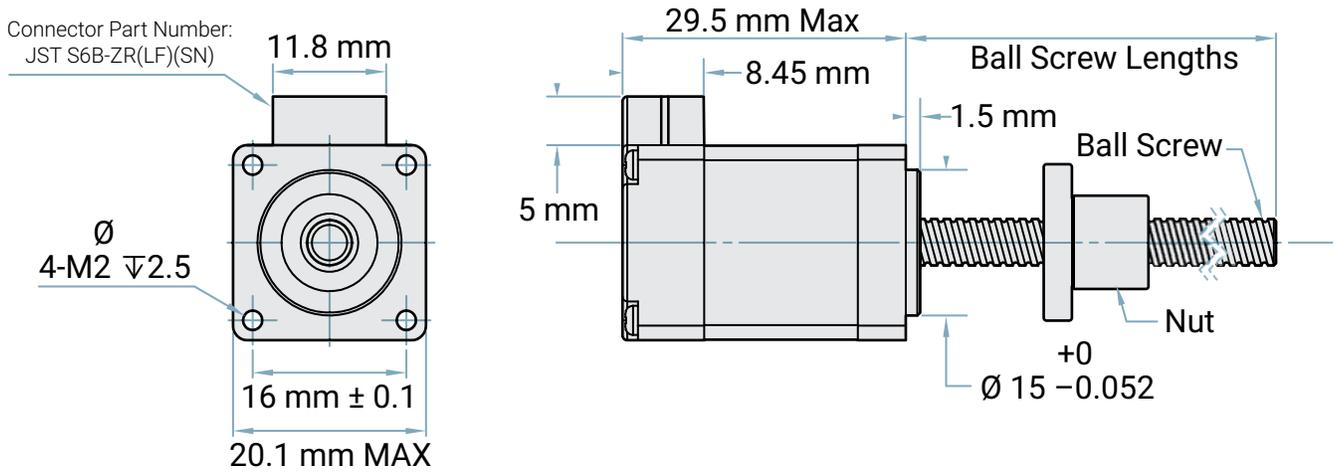
Motor Style	Motor Body Length (mm)	Electrical Connection	Rated Current (Amps)	Winding	
				Ohms	mH
				±10% at 20°C	Typical
NEMA 8	29.5	Plug In Connector	0.4	13.9	4

## Ball Screw Style for NEMA 8 Series

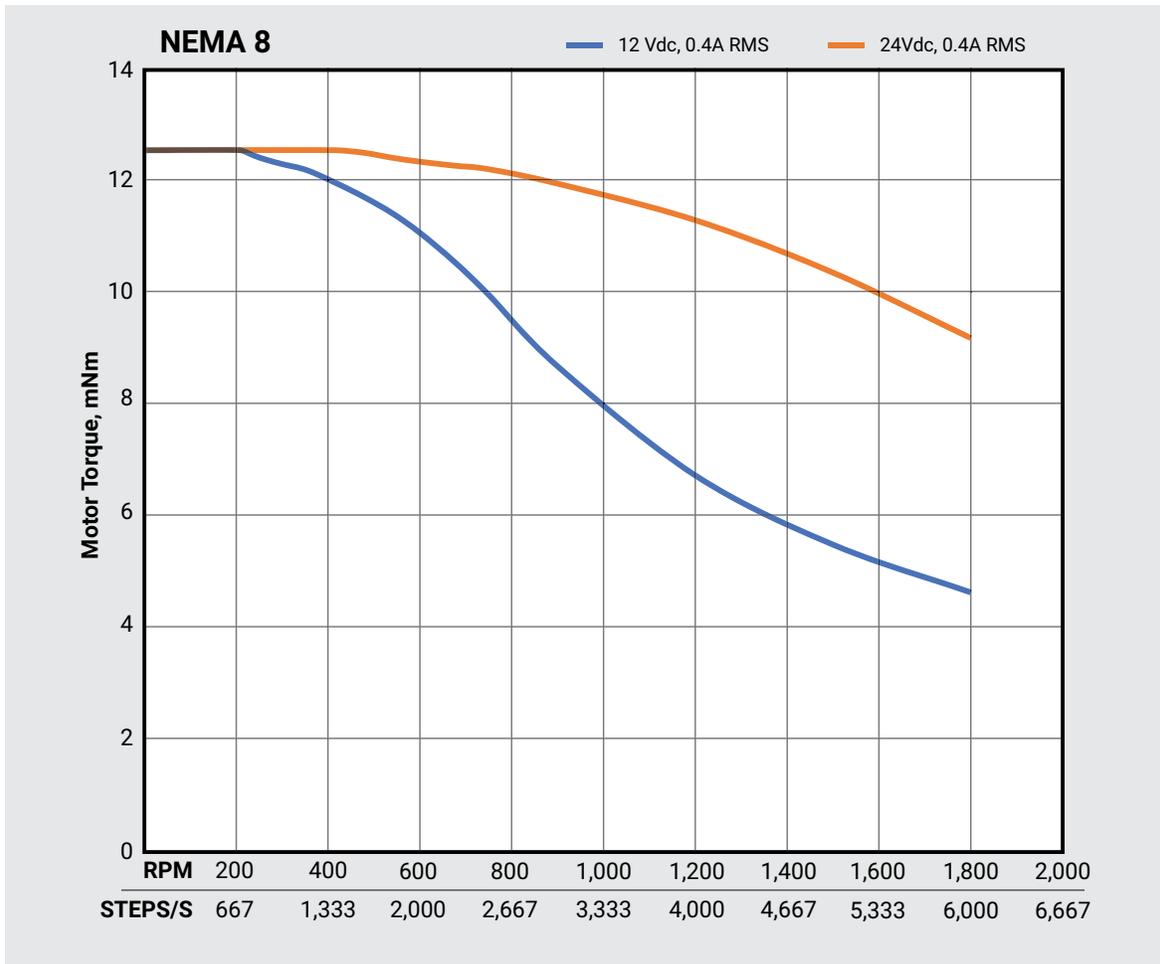
Ball Screw Style	External Diameter	Lead	Travel Per 1.8° Step
0601A	6 mm	1 mm	0.005"
0602A		2 mm	0.010 mm

**Note:** See page 25 for wiring harness information and diagram.

# NEMA 8 Series



## Speed Torque Curves



# NEMA 11 Series



Phases ..... 2  
 Steps/Revolution ..... 200  
 Step Accuracy ..... ±5%  
 IP Rating ..... 40

Approvals ..... RoHS  
 Operating Temp. .... -20°C–+50°C  
 Insulation Class ..... B (130°C)  
 Insulation Resistance..... 100 MΩ

## Step Motor - 4 Lead Bi-Polar

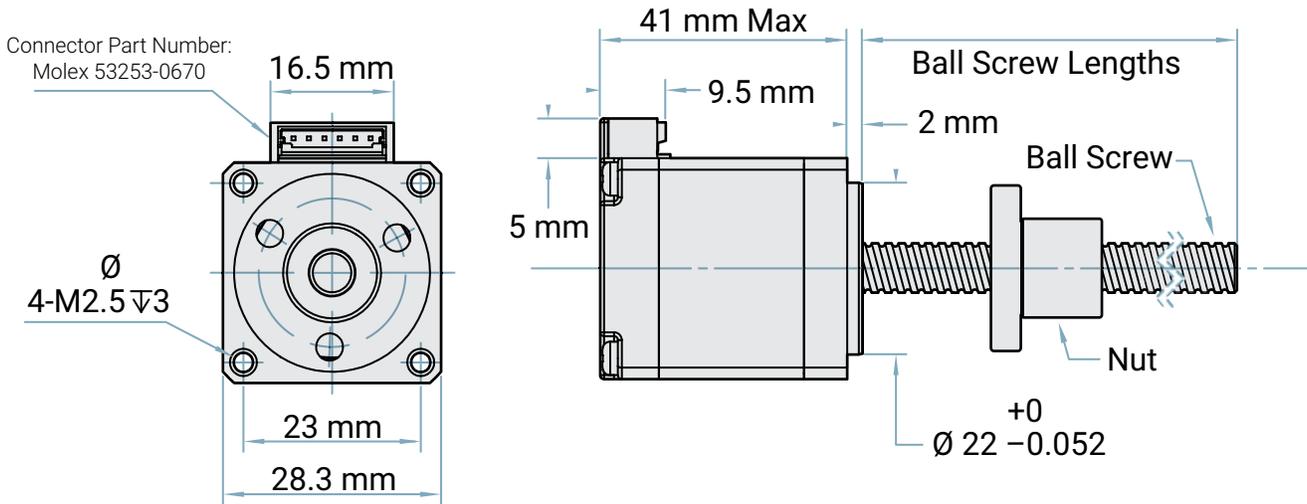
Motor Style	Motor Body Length (mm)	Electrical Connection	Rated Current (Amps)	Winding	
				Ohms	mH
				±10% at 20°C	Typical
NEMA 11	41	Plug In Connector	1	2.7	2.5

## Ball Screw Style for NEMA 11 Series

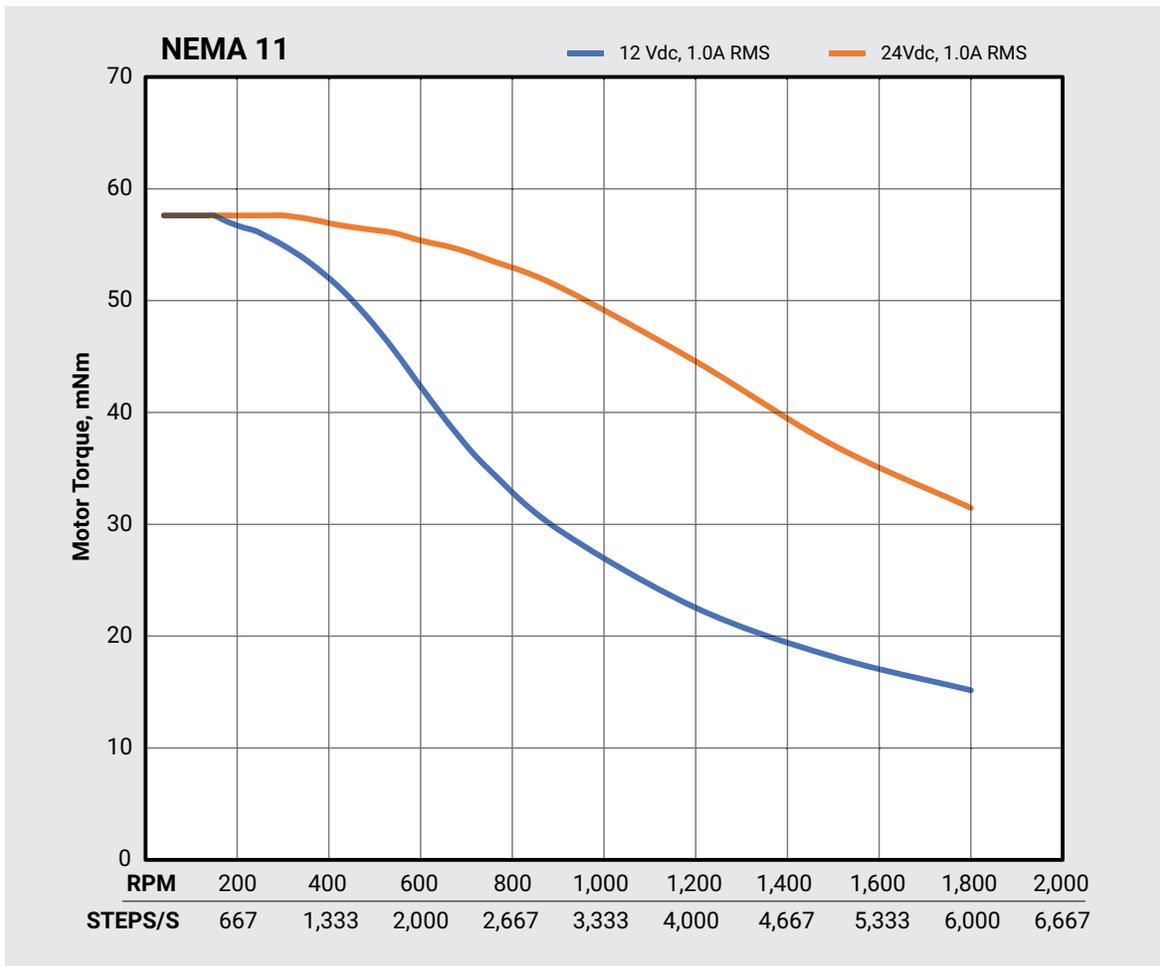
Ball Screw Style	External Diameter	Lead	Travel Per 1.8° Step
0601A	6 mm	1 mm	0.005"
0602A		2 mm	0.005 mm
0801A	8 mm	1 mm	0.020 mm
0802A		2 mm	0.010 mm
08025		2.5 mm	0.0125 mm

**Note:** See page 25 for wiring harness information and diagram.

# NEMA 11 Series



## Speed Torque Curves



# NEMA 14 Series



Phases.....	2	Approvals .....	RoHS
Steps/Revolution.....	200	Operating Temp. ....	-20°C–+50°C
Step Accuracy.....	±5%	Insulation Class .....	B (130°C)
IP Rating .....	40	Insulation Resistance.....	100 MΩ

## Step Motor - 4 Lead Bi-Polar

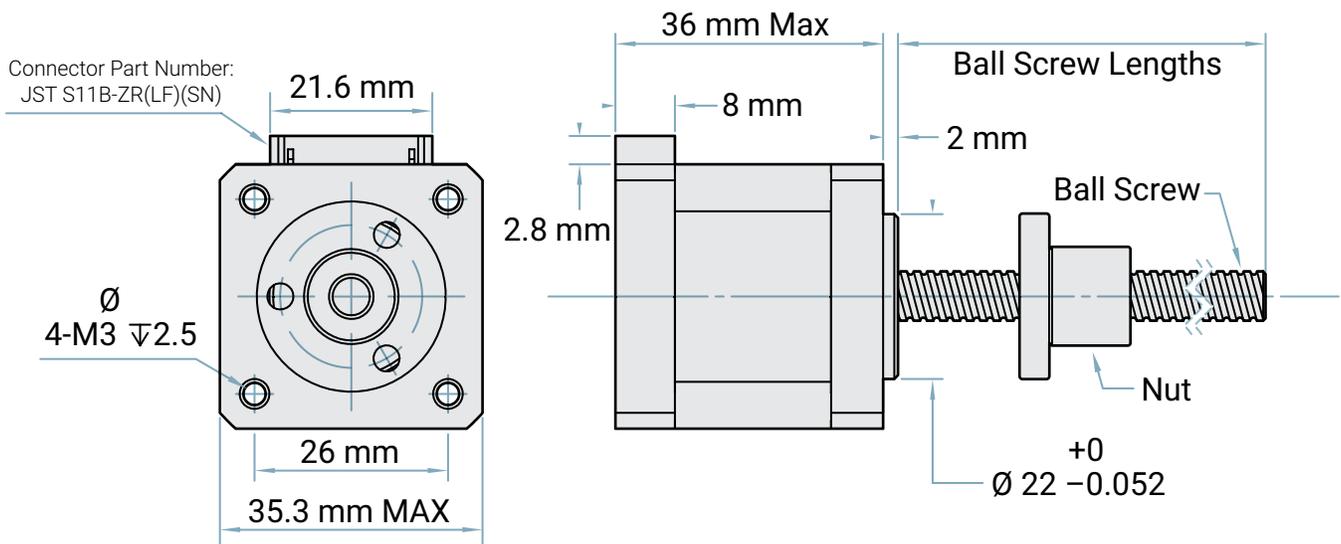
Motor Style	Motor Body Length (mm)	Electrical Connection	Rated Current (Amps)	Winding	
				Ohms	mH
				±10% at 20°C	Typical
NEMA 14	36	Plug In Connector	1.5	1.61	2.5

## Ball Screw Style for NEMA 14 Series

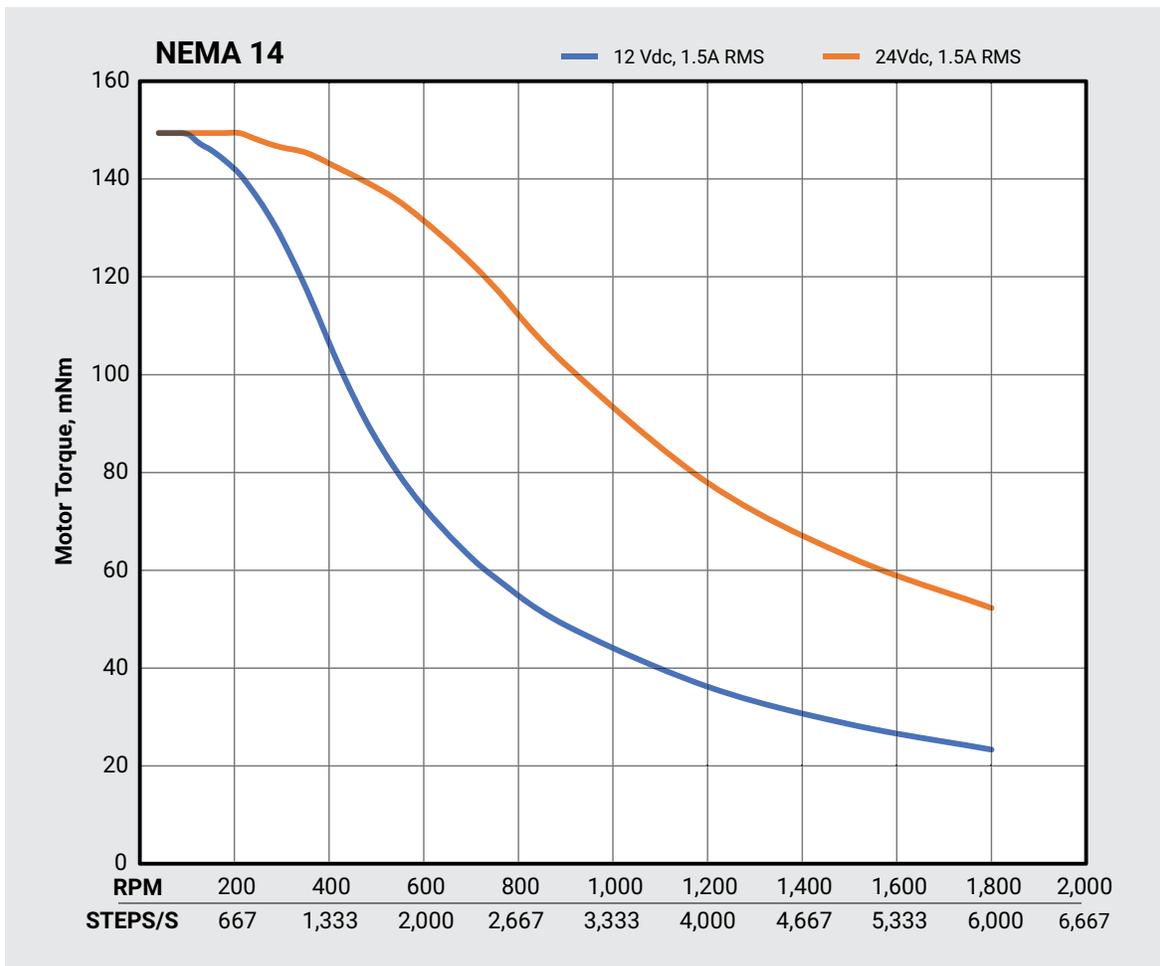
Ball Screw Style	External Diameter	Lead	Travel Per 1.8° Step
0601A	6 mm	1 mm	0.005 mm
0602A		2 mm	0.010 mm
0801A	8 mm	1 mm	0.005 mm
0802A		2 mm	0.010 mm
08025		2.5 mm	0.0125 mm
1002A	10 mm	2 mm	0.010 mm

**Note:** See page 25 for wiring harness information and diagram.

# NEMA 14 Series

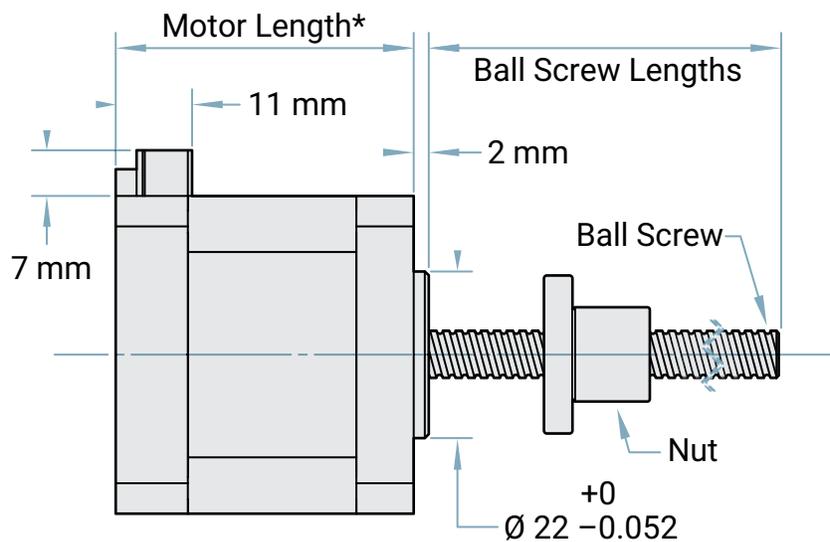
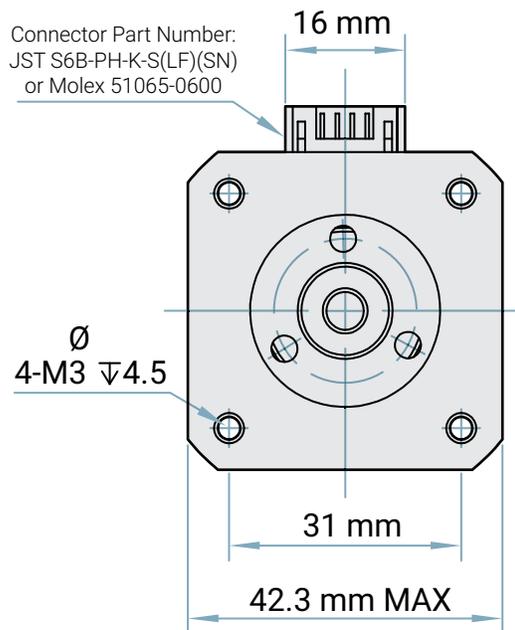


## Speed Torque Curves





# NEMA 17 Series

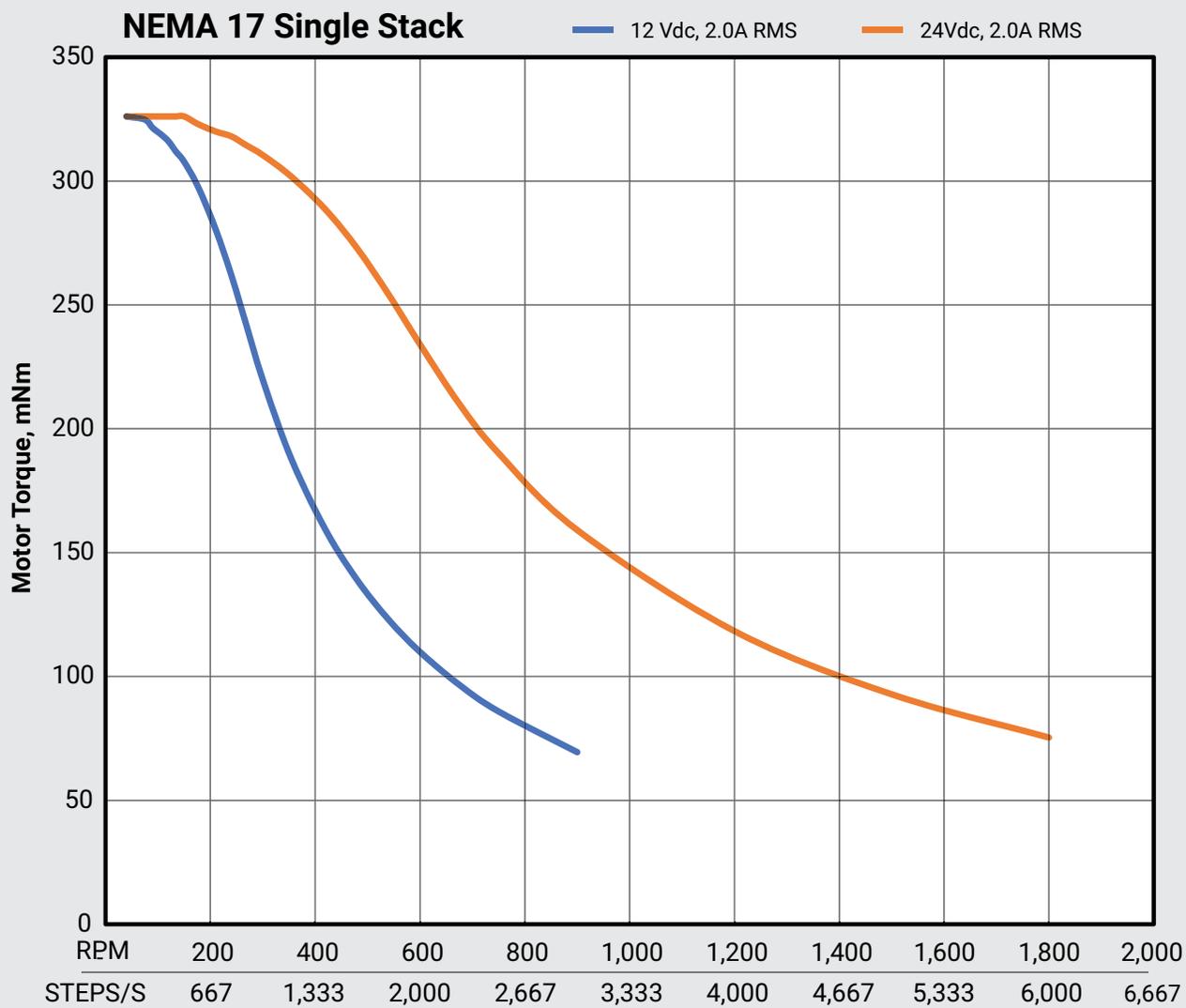


**\* Motor Lengths:**

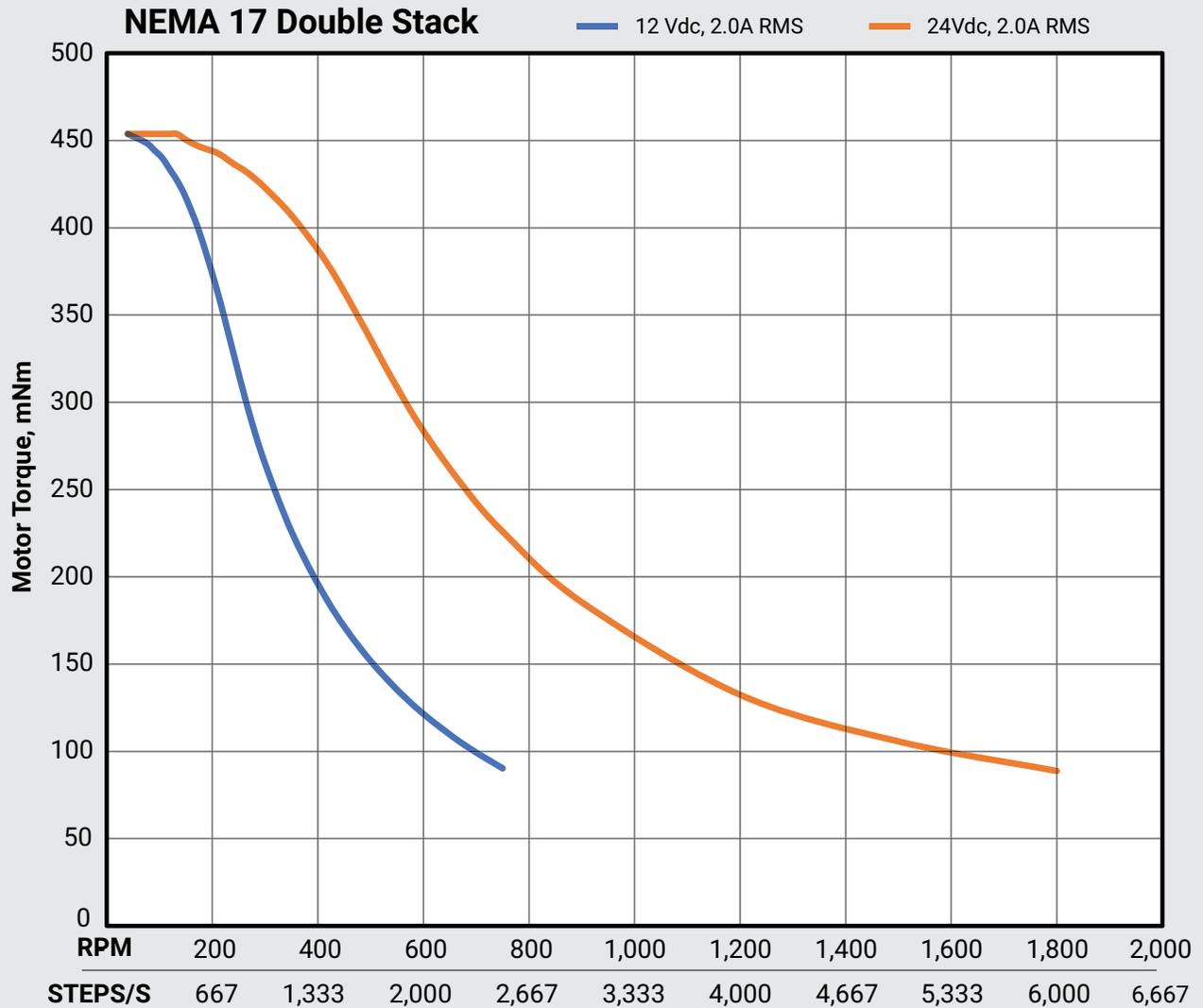
NEMA 17 Single Stack (171): 39.8 mm

NEMA 17 Double Stack (172): 48.3 mm

# NEMA 17 Series Speed Torque Curves



# NEMA 17 Series Speed Torque Curves



# NEMA 23 Series



Phases ..... 2  
 Steps/Revolution ..... 200  
 Step Accuracy ..... ±5%  
 IP Rating ..... 40

Approvals ..... RoHS  
 Operating Temp. .... -20°C–+50°C  
 Insulation Class ..... B (130°C)  
 Insulation Resistance..... 100 MΩ

## Step Motor - 4 Lead Bi-Polar

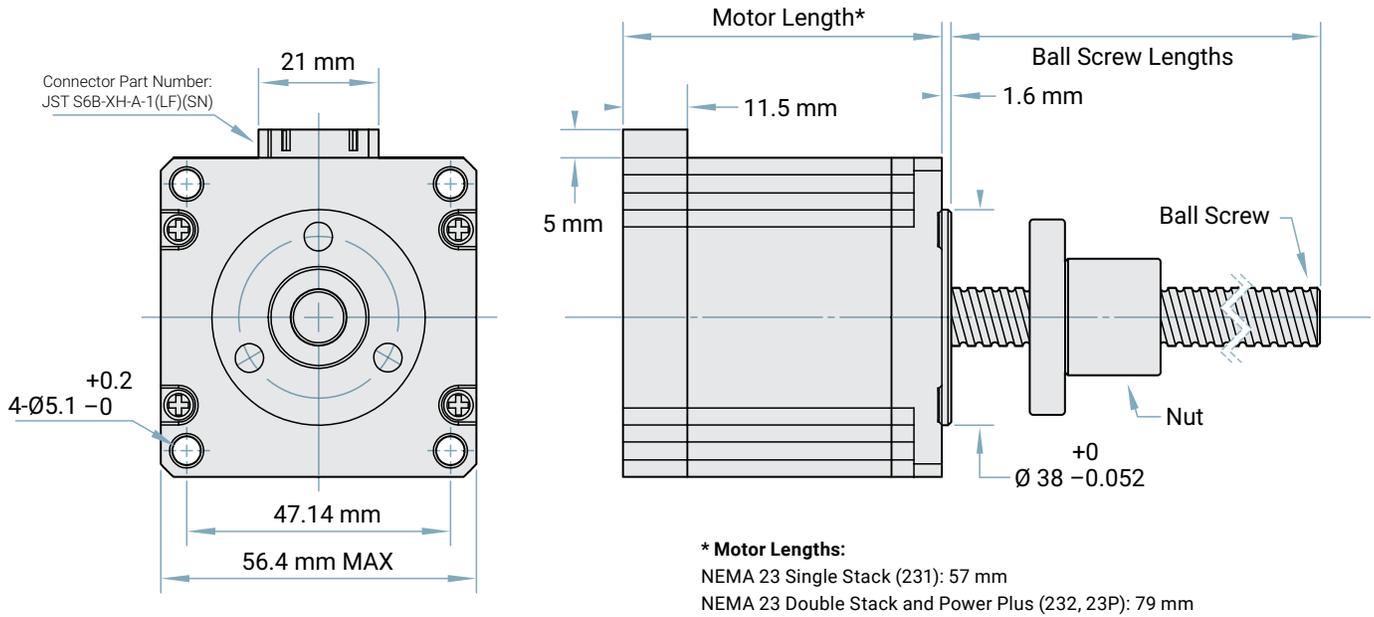
Motor Style	Motor Body Length (mm)	Electrical Connection	Rated Current (Amps)	Winding		Note
				Ohms ±10% at 20°C	mH Typical	
NEMA 23 Single Stack	57	Plug In Connector	2.2	1.6	7.2	Standard
NEMA 23 Double Stack	79	Plug In Connector	3.0	1.1	5.0	Standard
NEMA 23 Power Plus	79	Plug In Connector	3.0	1.1	3.7	PowerPlus

## Ball Screw Style for NEMA 23 Series

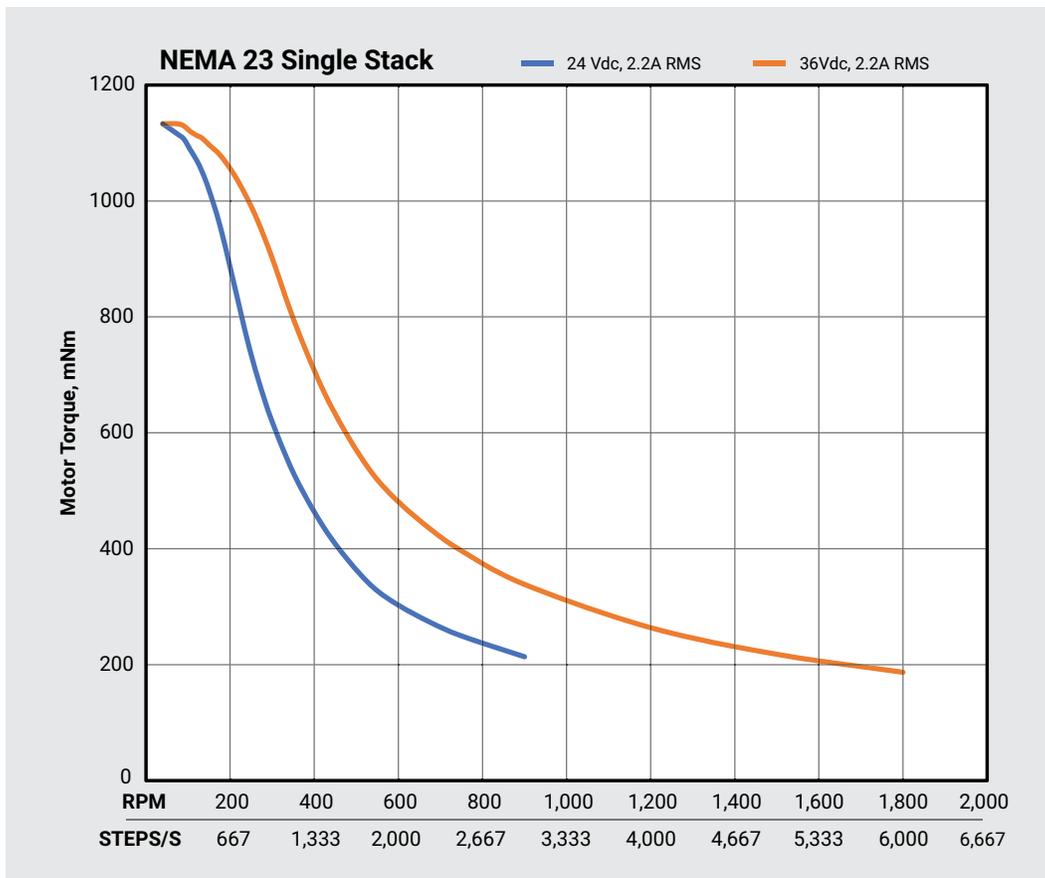
Ball Screw Style	External Diameter	Lead	Travel Per 1.8° Step
1002A	10 mm	2 mm	0.010 mm

**Note:** See page 25 for wiring harness information and diagram.

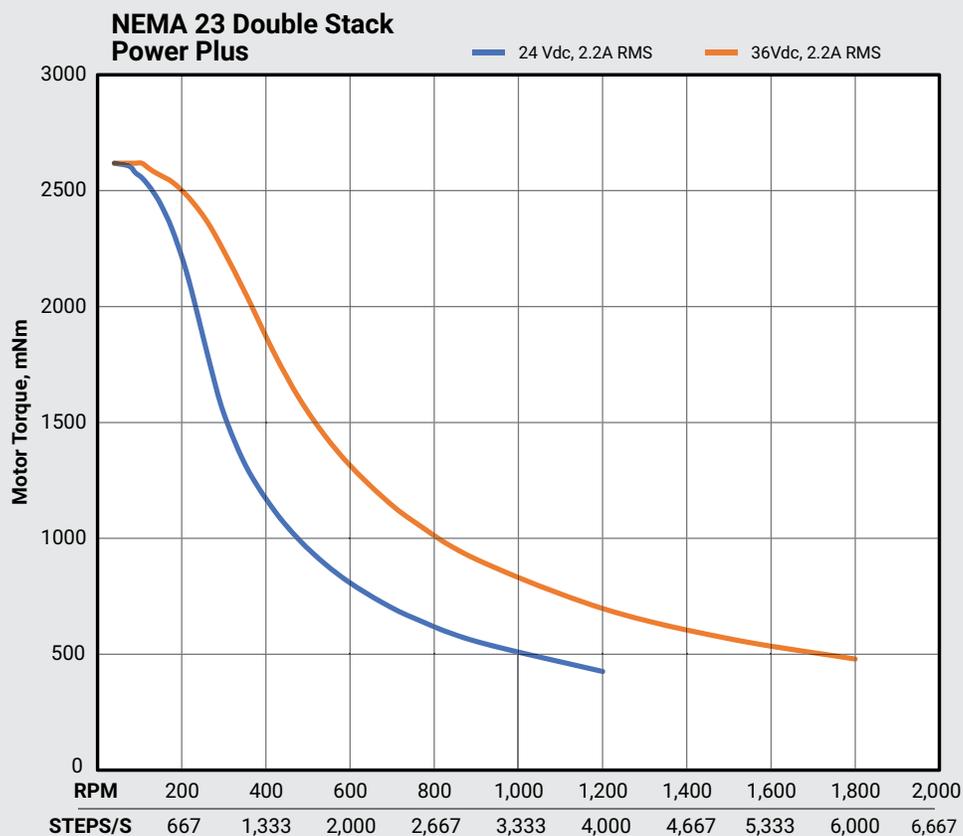
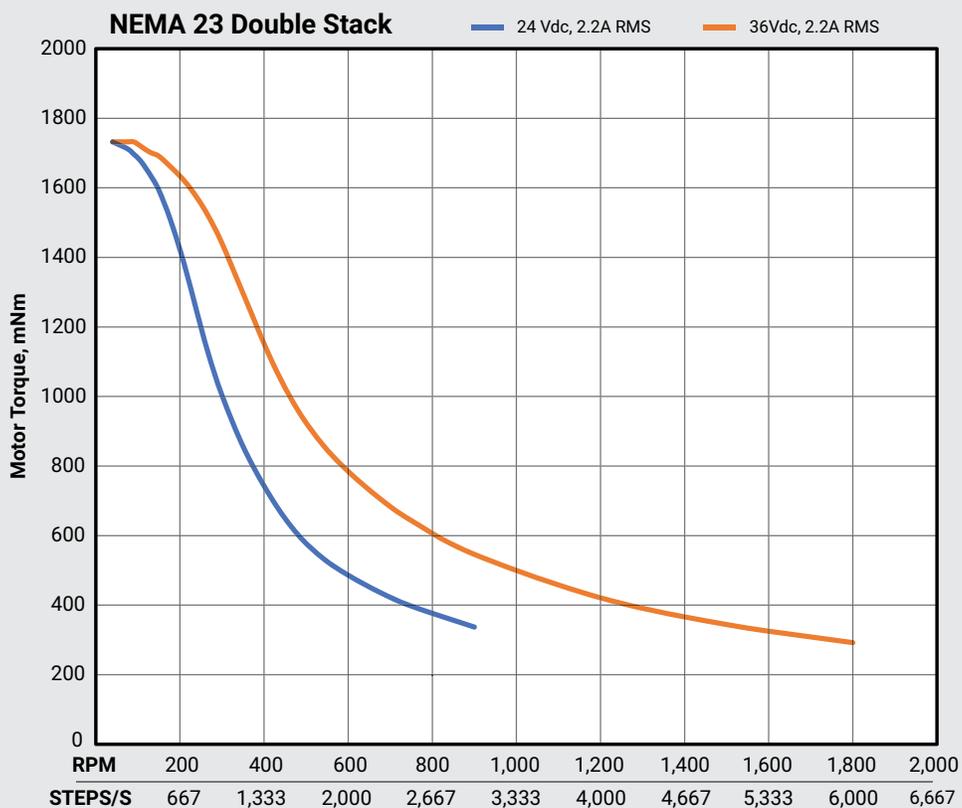
# NEMA 23 Series



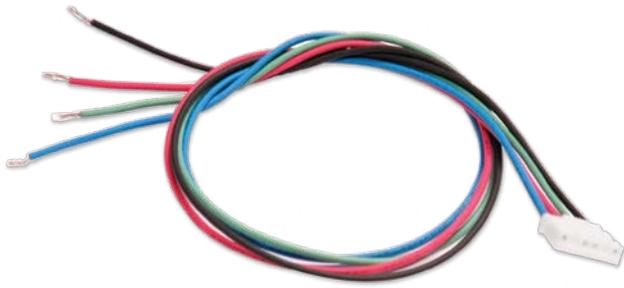
## Speed Torque Curves



# NEMA 23 Series Speed Torque Curves

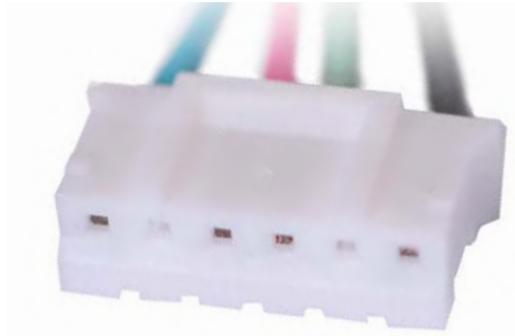
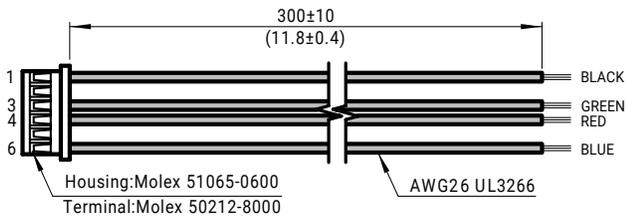


# Wiring Harness



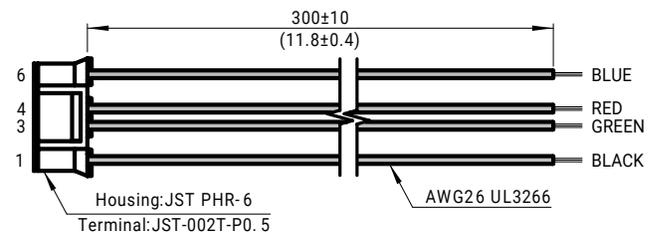
NEMA 11 Series

4 Lead Part Number 6200727



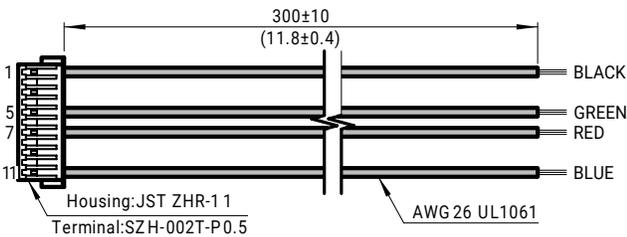
NEMA 17 Series

4 Lead Part Number 6200490



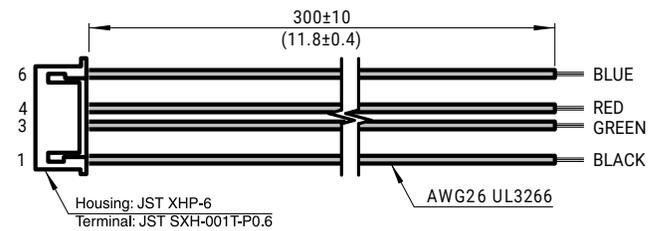
NEMA 14 Series

4 Lead Part Number 6200728



NEMA 23 Series

4 Lead Part Number 6200491



## Wiring Diagram

### Bipolar, Full Step

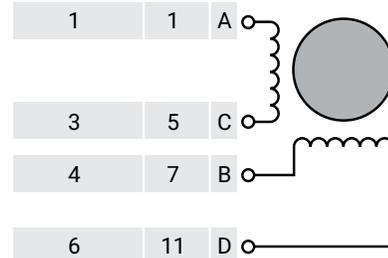
Step	Phase 1		Phase 2	
	A	C	B	D
1	+	-	+	-
2	-	+	+	-
3	-	+	-	+
4	+	-	-	+

CW (downward arrow) and CCW (upward arrow) rotation when seen from flange side of the motor.

### 4 Lead (bipolar)

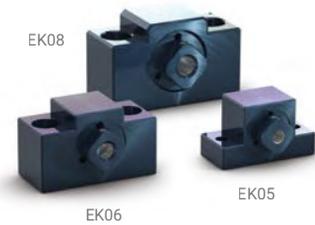
#### Connector Pin#

Motor Size	
8, 11, 17, 23	14

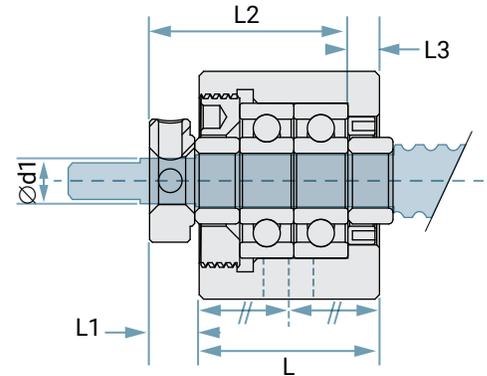
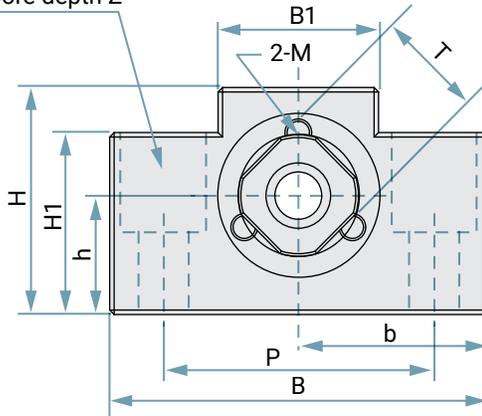


# Fixed Bearing Blocks

## EK Base Mount Fixed Bearing Blocks



2- $\varnothing$ X drill  $\varnothing$ Y counter bore depth Z



### Supported Journals:

- ALN - Fixed Journal End
- BLN - Fixed Journal End with Drive Extension
- CLN - Fixed Journal End with Drive Extension/Flat

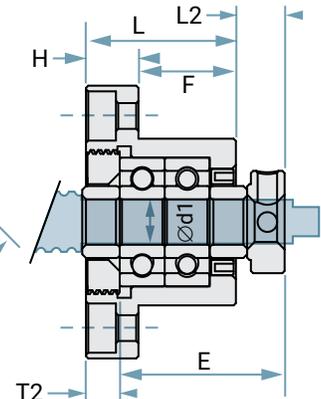
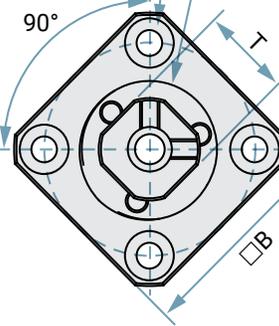
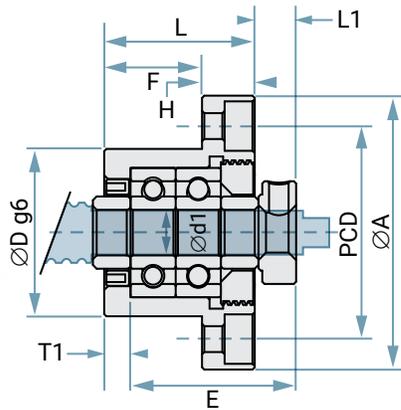
### Dimensions

Model No./Part No.	d1 Journal Diameter	L	L1	L2	L3	B	H	b	h	B1	H1	P	X	Y	Z	M	T	Weight
		mm	mm	mm	mm	mm	mm	±0.02	±0.02	mm	mm	mm	mm	mm	mm	mm	mm	Kgs
BSBLEB-05MMP	EK05	5	16.5	5.5	18.5	3.5	36	21	18	20	8	28	4.5	-	-	M3	11	0.10
BSBLEB-06MMP	EK06	6	20	5.5	22	3.5	42	25	21	18	20	30	5.5	9.5	11	M3	12	0.15
BSBLEB-08MMP	EK08	8	23	7.0	26	4.0	52	32	26	17	25	38	6.6	11	12	M3	14	0.26

## FK Axial Mount Fixed Bearing Blocks



4-X drill  $\varnothing$ Y counter bore depth Z



Mounting Method A

Mounting Method B

### Supported Journals:

- ALN - Fixed Journal End
- BLN - Fixed Journal End with Drive Extension
- CLN - Fixed Journal End with Drive Extension/Flat

### Dimensions

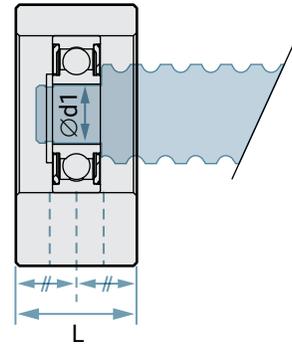
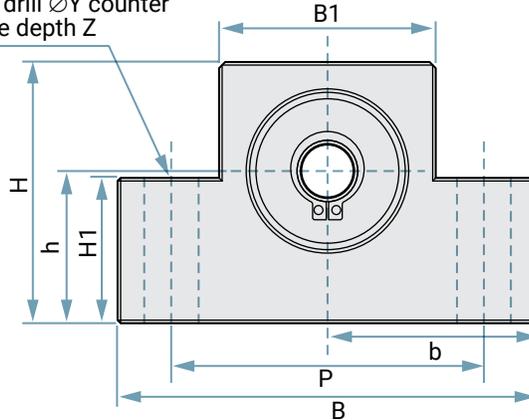
Model No./Part No.	d1 Journal Diameter	L	H	E	F	Dg6	A	PCD	B	Mounting A	Mounting B	X	Y	Z	M	T	Weight		
		mm	mm	mm	mm	-0.007 -0.02	mm	mm	mm	L1	T1	L2	T2	mm	mm	mm	mm	Kgs	
BSALEB-05MMP	FK05	5	16.5	6	18.5	10.5	20	34	26	5.5	3.5	5	3	3.4	6.5	3.5	M3	11	0.08
BSALEB-06MMP	FK06	6	20	7	22	13	22	36	28	5.5	3.5	6.5	4.5	3.4	6.5	4	M3	12	0.10
BSALEB-08MMP	FK08	8	23	9	26	14	28	43	35	7	4	8	5	3.4	6.5	4	M3	14	0.15

# Floating Bearing Blocks

## EF Base Mount Floating Bearing Blocks



2-X drill  $\varnothing Y$  counter bore depth Z



### Supported Journals:

AFN - Float Journal End  
 BFN - Float Journal End with Drive Extension  
 CFN - Float Journal End with Drive Extension/Flat

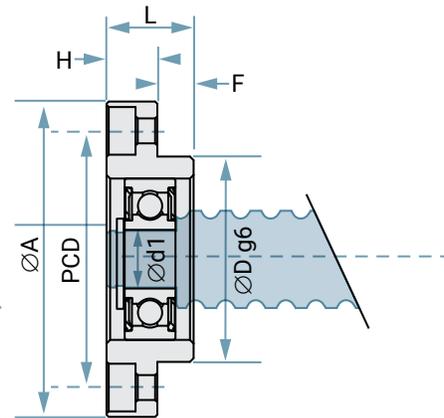
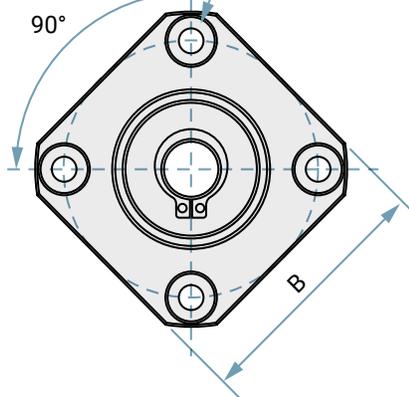
### Dimensions

Model No./Part No.	d1 Journal Diameter	L mm	B mm	H mm	b ±0.02	h ±0.02	B1 mm	H1 mm	P mm	X mm	Y mm	Z mm	Bearing	Snap Ring	Weight Kgs	
BSBFEB-06MMP	EF06	6	12	42	25	21	13	18	20	30	5.5	9.5	11	606ZZ	S 06	0.10
BSBFEB-08MMP	EF08	6	14	52	32	26	17	25	26	38	6.6	11	12	606ZZ	S 06	0.15
BSBFEB-10MMP	EF10	8	20	70	43	36	25	36	24	52	9	-	-	608ZZ	S 08	0.33

## FF Axial Mount Floating Bearings Blocks



4-X drill  $\varnothing Y$  counter bore depth Z



### Supported Journals:

AFN - Float Journal End  
 BFN - Float Journal End with Drive Extension  
 CFN - Float Journal End with Drive Extension/Flat

### Dimensions

Model No./Part No.	d1 Journal Diameter	L mm	H mm	F mm	Dg6 -0.007 -0.02	A mm	PCD mm	B mm	X mm	Y mm	Z mm	Bearing	Snap Ring	Weight Kgs	
BSAFEB-06MMP	FF06	6	10	6	4	22	36	28	28	3.4	6.5	3.5	606ZZ	S 06	0.06
BSAFEB-10MMP	FF10	8	12	7	5	28	43	35	35	3.4	6.5	4	608ZZ	S 08	0.10

# Technical • MAX Speed Calculations

## Calculating the Maximum Speed of a Ball Screw System

The maximum speed possible for a ball screw assembly depends on the ball screw diameter, the unsupported length of the ball screw, how the ball screw is supported, the type of lubrication system (oil or grease), and the construction of the ball return system in the ball nut.

### I. Critical Speed of the Ball Screw

The critical speed of a ball screw is its first natural frequency. PBC Linear recommends operating below 80% of the ball screw's critical speed. The critical speed of a ball screw is dependent on its root diameter, its unsupported length, and how its ends

are supported. Fig. 1 shows the 80% critical speed values for PBC ball screws corresponding to the formula below.

$$n_{max} = K \cdot 10^6 \cdot \frac{d_2}{l_a^2} \cdot S.F.$$

where:

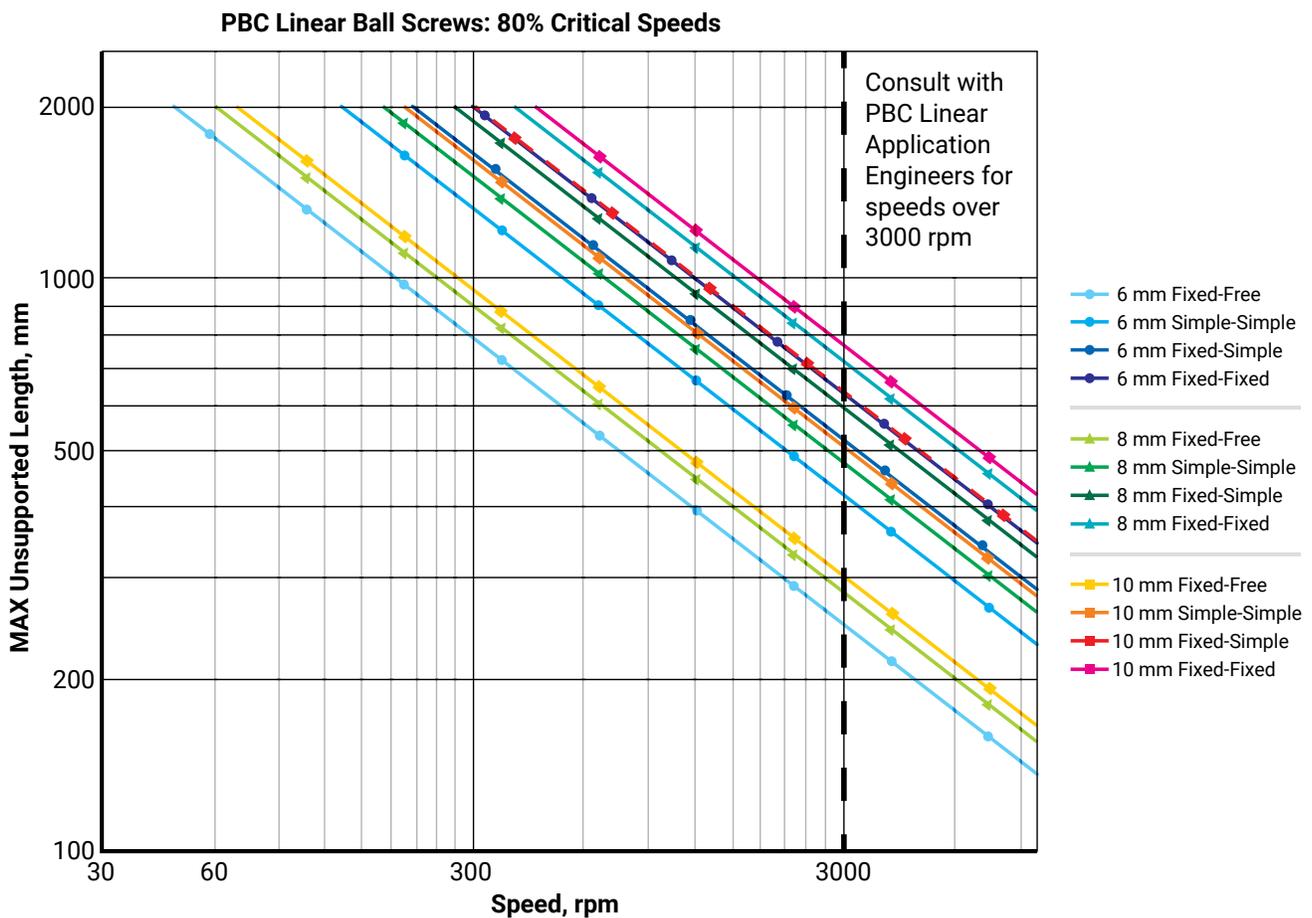
$n_{max}$  = maximum rotational speed (rpm)

$K$  = factor for the type of ball screw supports (see fig. 2)

$d_2$  = screw thread root diameter (mm)

$l_a$  = maximum unsupported length (mm) (see fig. 2)

$S.F.$  = safety factor 0.8



# Technical • MAX Speed/MAX Static Load Calculations

## Types of Ball Screw Supports

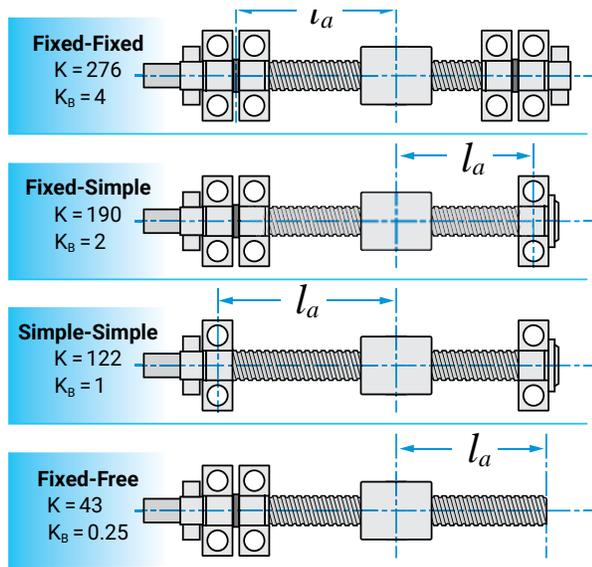


Figure 2

### II. Maximum Speed of the Ball Return System

The rotational speed characteristic for ball nuts with multiliner ball returns and rolled ball screws. If the ball screw is relatively lightly loaded and it is properly lubricated, the maximum possible speed allowed by the ball return system can be estimated by the formulas below.

$$D_m \cdot N \leq 50,000$$

$$n_{max} = \frac{D_m \cdot N}{d_1}$$

where:

$n_{max}$  = maximum rotational speed (rpm)

$D_m \cdot N$  = rotational speed characteristic of the ball return system (rpm • mm)

$d_1$  = ball screw's nominal (outside) diameter (mm)

**Note:** For maximum speeds greater than 3000 rpm, please consult with a PBC Linear Applications Engineer.

### III. Maximum Traverse Speed

Once limiting  $n_{MAX}$  is found in I (Critical Speed) or II (Maximum Speed), the maximum traverse speed

can be calculated using the formula below with the lower  $n_{MAX}$ :

$$V_{max} = \frac{n_{max} \cdot P_h}{60}$$

where:

$V_{max}$  = maximum possible traverse speed (mm/sec)

$P_h$  = thread lead (mm)

## Maximum Static Loading Calculations

### I. The maximum permissible static load, $F_{per}$

$$F_{per} = \frac{C_{0a}}{f_s} (N)$$

where:

$F_{per}$  = maximum permissible static load derated for application conditions (N)

$f_s$  = derate factor based on application conditions

Machine Type	Conditions	( $f_s$ ) Factor
General Machinery	No Vibration or Impacts	1.0 to 2.0
	with Vibration or Impacts	2.5 to 7.0
Machine Tools	No Vibration or Impacts	1.0 to 1.5
	with Vibration or Impacts	2.0 to 3.0

### II. Permissible buckling force, $F_B$

Ball screws should be loaded in axial compression to levels below their maximum column loading. Exceeding the maximum column loading can result in instability due to screw bending or buckling.

$$F_B = \frac{K_B \cdot d_2^4}{S_B \cdot l_a^2} \cdot 10^5 (N)$$

where:

$K_B$  = factor for end support designs (see fig.2)

$d_2$  = thread root diameter of the ball screw (mm)

$S_B$  = factor of safety for buckling. Normally 2...4

$l_a$  = maximum screw length acted upon by axial force (mm)

# Technical • Life Calculation

## Calculating the Nominal Service Life $L_{10}$ or $L_h$

The formula to calculate the service life that 90% of identical, properly lubricated ball screws are expected to reach is given below:

$$L_{10} = \left( \frac{C_a}{F_m} \right)^3 \cdot 10^6 \text{ (revolutions)}$$

where:

$L_{10}$  = service life (revolutions)

$C_a$  = dynamic load rating (N)

$F_m$  = average axial load (N)

$$L_h = \frac{L_{10}}{n_m \cdot 60} \text{ (hours)}$$

where:

$L_h$  = service life (hours)

$n_m$  = average rotational speed (rpm)

In applications where vibration or impact loading is present, or if the application speed is very high, then the nominal life calculations can be adjusted as follows:

$$L_{10} = \left( \frac{C_a}{f_w \cdot F_m} \right)^3 \cdot 10^6 \text{ (revolutions)}$$

### Load Drate Factor ( $f_w$ )

Vibration or Impact	( $f_w$ ) Factor
Minor	1.0 to 1.2
Low	1.2 to 1.5
Moderate	1.5 to 2.0
High	2.0 to 3.5

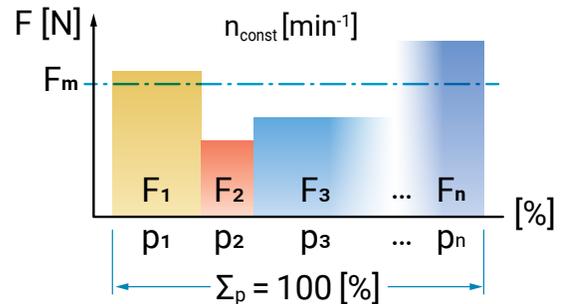
## I. Average axial load $F_m$ for constant rotational speed and varying axial load

$$F_m = \sqrt[3]{F_1^3 \cdot \frac{p_1}{100} + F_2^3 \cdot \frac{p_2}{100} + \dots + F_n^3 \cdot \frac{p_n}{100}} \text{ (N)}$$

where:

$F_{1,2,..n}$  = load per cycle unit (N)

$p_{1,2,..n}$  = cycles (%)



$$L_{10} = \left( \frac{C_a}{F_m} \right)^3 \cdot 10^6 \text{ (revolutions)}$$

$$L_h = \frac{L_{10}}{n_m \cdot 60} \text{ (hours)}$$

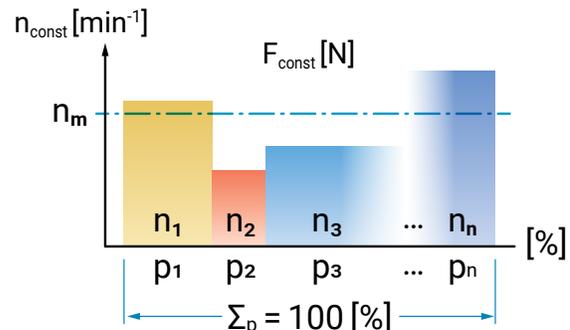
## II. Average rotational speed at constant axial load $F_{const}$ and variable rotational speed

$$n_m = n_1 \cdot \frac{p_1}{100} + n_2 \cdot \frac{p_2}{100} + \dots + n_n \cdot \frac{p_n}{100} \text{ (rpm)}$$

where:

$n_{1,2,..n}$  = rotational speed per cycle unit (rpm)

$p_{1,2,..n}$  = cycles (%)



# Technical • Life Calculation-cont./Ball Screw Grading

## II. Average rotational speed (cont.)

$$L_{10} = \left( \frac{C_a}{F_{const}} \right)^3 \cdot 10^6 \text{ (revolutions)}$$

$$L_h = \frac{L_{10}}{n_m \cdot 60} \text{ (hours)}$$

## III. Average axial force and average rotational speed when the axial load and the rotational speed vary between different values.

$$F_m = \sqrt[3]{F_1^3 \cdot \frac{p_1}{100} + F_2^3 \cdot \frac{p_2}{100} + \dots + F_n^3 \cdot \frac{p_n}{100}} \text{ (N)}$$

$$n_m = n_1 \cdot \frac{P_1}{100} + n_2 \cdot \frac{P_2}{100} + \dots + n_n \cdot \frac{P_n}{100}$$

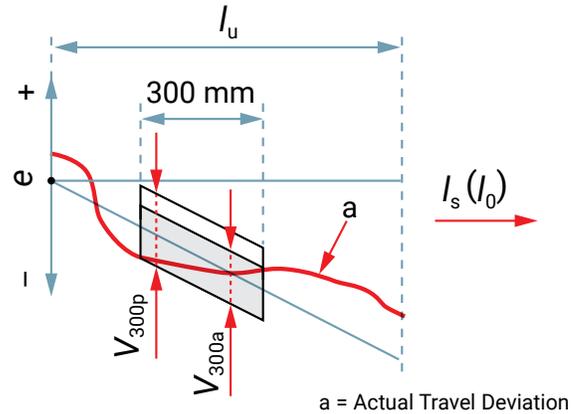
$$L_{10} = \left( \frac{C_a}{F_m} \right)^3 \cdot 10^6 \text{ (revolutions)}$$

$$L_h = \frac{L_{10}}{n_m \cdot 60} \text{ (hours)}$$

## Positioning or Transport Ball Screws

Ref: ISO 3408-3 E3

Checking of the travel variation  $V_{300}$  within an axial travel of 300 mm:



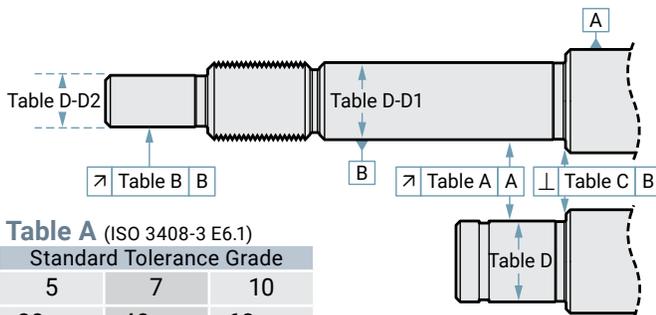
### Permissible Deviations

Standard Tolerance	$V_{300p}$ $\mu\text{m}$
Grade 5	23
Grade 7	52 <sup>a</sup>
Grade 10	210 <sup>a</sup>

<sup>a</sup> = Only for transport ball screws

## Positioning or Transport Ball Screws

Ref: ISO 3408-3



**Table A** (ISO 3408-3 E6.1)  
Standard Tolerance Grade

5	7	10
20 $\mu\text{m}$	40 $\mu\text{m}$	63 $\mu\text{m}$

**Table B** (ISO 3408-3 E7.2)  
Standard Tolerance Grade

5	7	10
10 $\mu\text{m}$	-	-

**Table C** (ISO 3408-3 E8.2)  
Standard Tolerance Grade

5	7	10
5 $\mu\text{m}$	-	-

**Table D** Journal Diameters

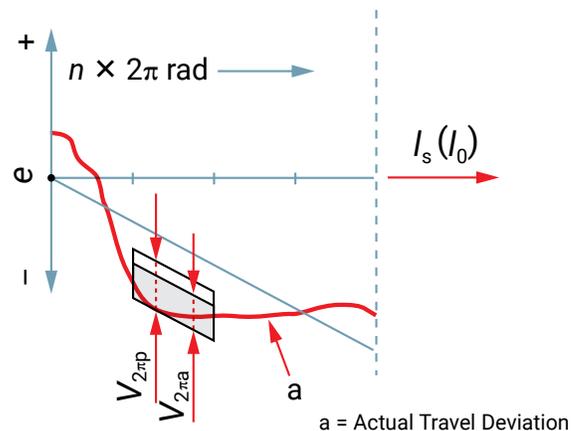
	D1	D2
Turned	Nom. -22 $\mu\text{m}$ / -34 $\mu\text{m}$	Nom. h7
Ground	Nom. -8 $\mu\text{m}$ / -15 $\mu\text{m}$	Nom. h7

Grade 7 and 10 ball screws have turned journals standard.  
Grade 5 ball screws have ground journals standard.  
Turned or ground journals can be requested where not standard.

## Positioning Ball Screws

Ref: ISO 3408-3 E4

Checking of the travel variation  $V_{2\pi p}$  within  $2\pi$  rad:



### Permissible Deviations

Standard Tolerance	$V_{2\pi p}$ $\mu\text{m}$
Grade 5	8



A Pacific Bearing Company

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