



MINIATURE PRECISION TORQUE SPLINES





Helix Linear Technologies, Inc., Beachwood, Ohio

COMPANY

Helix is a global supplier to the Medical Device, Life Science, Security, Semiconductor, Aerospace, Electromechanical and Defense industries. Helix leads the linear motion industry by manufacturing the highest quality linear actuation solutions in the world. We focus entirely on manufacturing electro-mechanical actuation systems that help our customer be more productive and profitable. Our execution of innovative product designs solves real problems for our customers and builds a foundation for long term success.

HISTORY

Helix was founded in 2011 to manufacture high-quality lead screws for the growing electromechanical actuation industry. Helix's rapid growth has included the addition of linear actuator solutions to deliver integrated and turnkey solutions.

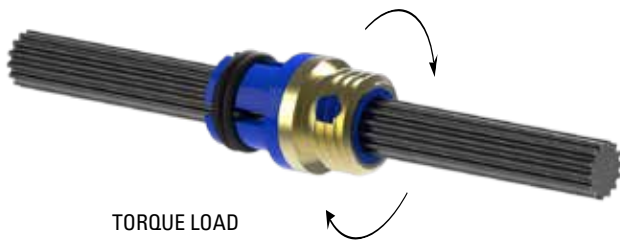
CULTURE

Our culture is based on a team of smart, happy and competitive professionals focused on manufacturing innovative products centered on delivering precise electromechanical linear motion solutions. We are in the people business, as well as the product business. People make and sell our products and a team of smart, happy and competitive people make a company healthy.

OPERATIONS

Our company is built to deliver high-quality products and engineering support to solve the most demanding linear motion applications in any industry. We deliver components and sub-system solutions to high volume OEMs and custom machine builders to help secure their success.

Glossary and Technical Data



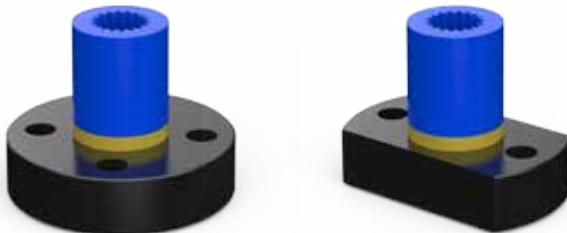
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FEATURES AND BENEFITS

The Helix Linear Precision Torque™ Splines are a convenient and efficient device that allows low friction motion while transmitting torque. In a Helix PT Spline assembly the high strength composite polymer bushing carries the load between the rotating member (inner race) and the rotating/translating member (bushing).

Helix PT Splines are coated with Helix H4X™ PTFE coating for long life and anti-friction. The PT bushings are offered in a standard freewheeling design and an anti-backlash design. These bushings can be mounted using an integral thread or they

can be assembled using a round or compact mounting flange shown on page 7.

The Helix PT Splines and Bushings can be modified to custom designs and configurations. Contact Helix Sales Engineers at sales@helixlinear.com. Helix Linear will provide customer specific part numbers on request - email your drawings to sales@helixlinear.com

SPLINE TERMS

EQUIVALENT DIAMETER – The equivalent diameter is the average diameter between the root diameter and the shaft diameter.

SHAFT DIAMETER - The shaft diameter is the outside diameter of the inner race.

ROOT DIAMETER - The root diameter is the diameter of the inner race measured at the bottom of the groove. This is the diameter used for determining column strength, critical speed and machining dimensions.

SPLINE TEETH - The grooves in the inner race that mate with the outer race are referred to as the spline teeth. The number of teeth varies with the diameter of the spline shaft. (See below)

Spline Shaft Diameter	Number of Teeth
0.250" (6.35mm)	14
0.375" (9.52mm)	16
0.500" (12.7mm)	18

STRAIGHTNESS - Although Precision Torque™ Splines are manufactured from straight, cylindrical material, internal stresses may cause the material to bend. When ordering random lengths or cut material without end machining, straightening is recommended. Handling or machining of splines can also cause the material to bend. Before, during and after machining, additional straightening may be required. When ordering splines with machined ends from Helix Linear, the following straightness tolerances can be expected: Precision Torq™ Splines are straight within .003" in per foot when shipped from the factory, and do not exceed .030 inch in any 6 foot section.

MAXIMUM TWIST - Precision Torque™ Splines will have a maximum twist of 3°/ft about the Spline Shaft axis.

ROTATIONAL LASH - Backlash or lash is the relative rotational movement of an outer race with no rotation of the inner race (or vice versa). Rotational backlash for the Precision Torque™ Splines with standard bushing is limited to a range of .005" to .009" at the equivalent diameter.

TEMPERATURE – Precision Torque™ Splines will operate between -65°F and 200°F with proper lubrication.

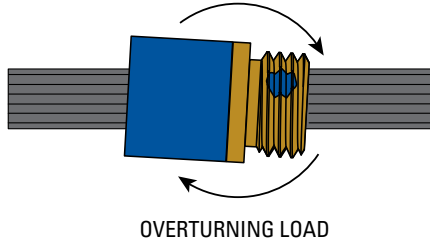
END MACHINING - To obtain optimum performance of your spline assembly, it is recommended that the machining be performed at the Helix Linear factory. Splines may be purchased machined to your specifications.

END FIXITY - End fixity refers to the method by which the ends of the spline are supported.

CRITICAL SPEED - The speed that excites the natural frequency of the spline inner race is referred to as the critical speed. Resonance at the natural frequency of the inner race will occur regardless of orientation (vertical, horizontal, etc.). The critical speed will vary with the diameter, unsupported length, end fixity and rpm. Since critical speed can also be affected by shaft straightness and assembly alignment, it is recommended that the maximum speed be limited to 80% of the calculated value. The formula used to calculate critical speed is found on page 220. The critical speed chart can also be used to quickly determine the minimum diameter.

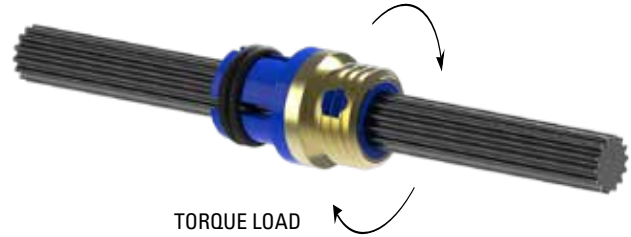
LOAD DEFINITIONS

OVERTURNING LOAD - A load that rotates the outer race around the longitudinal axis of the inner race. (See below)



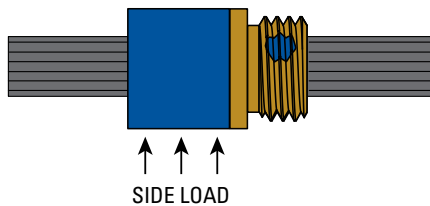
OVERTURNING LOAD

TORQUE LOAD - A load that rotates around the radial axis of the inner race/spine. (See below)



TORQUE LOAD

SIDE LOAD - A load that is applied radially to the outer race. (See below)



SIDE LOAD

PRELOAD - Preload is a load introduced between bushing and spline that eliminates radial movement. Preloaded assemblies provide zero backlash for excellent repeatability and increased system stiffness.

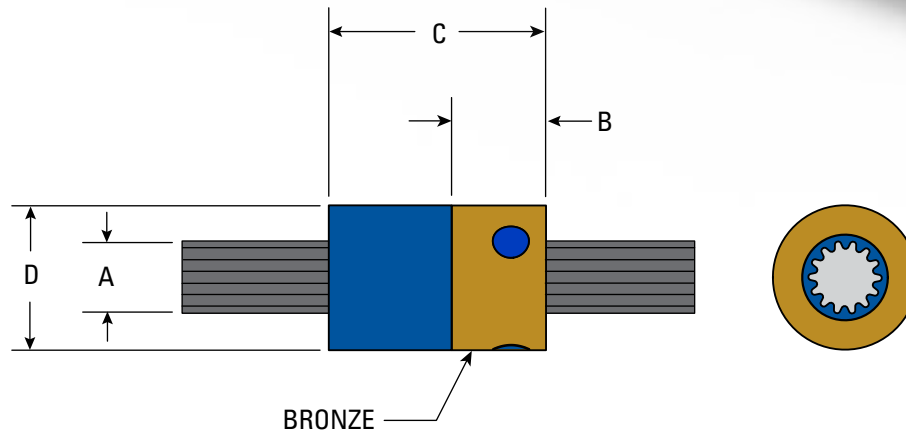
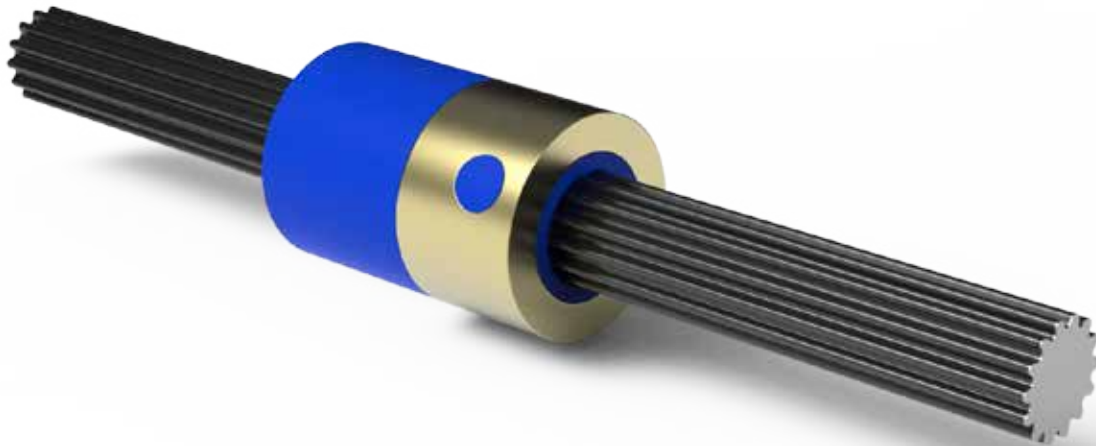
MATERIAL SPECIFICATIONS

Precision Torque™ inner races are made of high quality 304 stainless steel and coated with H4X PTFE coating. Precision Torque™ bushings are made of high strength bronze and Helix brand high-load composite polymer.

PTA ORDERING GUIDE TABLE

Bushing Style	Spline Diameter	Mounting	Number of bushings per spline	Coating Type	Length	
PTS Standard Bushing	04 1/4"	R Round Flanged	01 02 03 04	HX4 Helix PTFE	Length (inch) example: 10.00	
	06 3/8"	C Compact Flanged				
T Threaded Mount						
PTA Anti-backlash Bushing	08 1/2"	P Plain Mount				
PTA	04	F	01	H4X		12.00

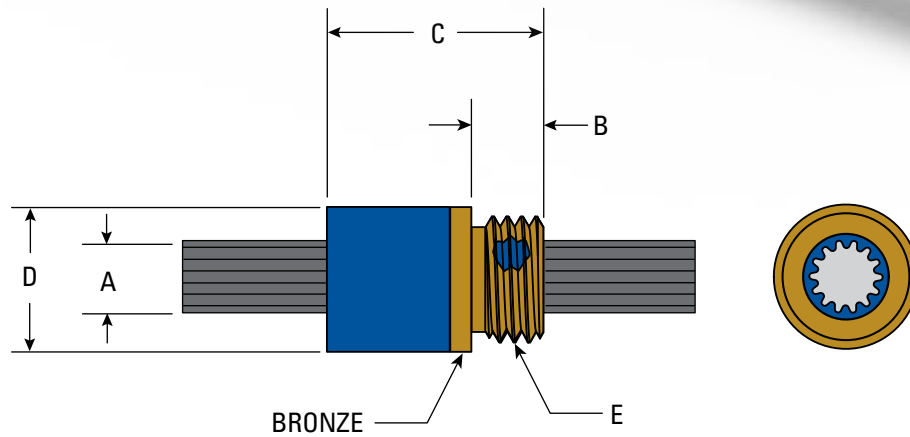
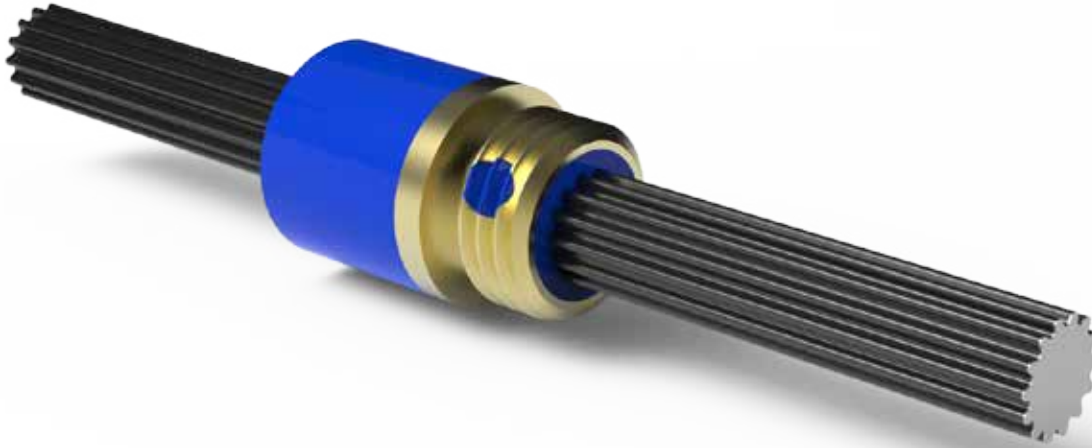
CYLINDER MOUNT BUSHINGS



SPECIFICATIONS

RAIL DIAMETER	(A) SHAFT DIAMETER	ROOT DIAMETER	EQUIVALENT DIAMETER	(B) MOUNTING SURFACE LENGTH	(C) BUSHING LENGTH	(D) BUSHING DIAMETER
Tolerances	± .002" [± .05 mm]	± .002" [± .05 mm]"	± .002" [± .05 mm]"	± .005" [± .13 mm]"	± .015" [± .38 mm]"	± .001" [± .05 mm]"
1/4"	0.250"	0.202"	0.226"	0.325"	0.75"	0.500"
	6.35 mm	5.13 mm	5.74 mm	8.26 mm	19.05 mm	12.70 mm
3/8"	0.375"	0.306"	0.343"	0.333"	1.00"	0.625"
	9.53 mm	7.77 mm	8.71 mm	8.46 mm	25.40 mm	15.88 mm
1/2"	0.500"	0.419"	0.460"	0.625"	1.50"	0.813"
	12.70 mm	10.64 mm	11.68 mm	15.88 mm	38.10 mm	20.64 mm

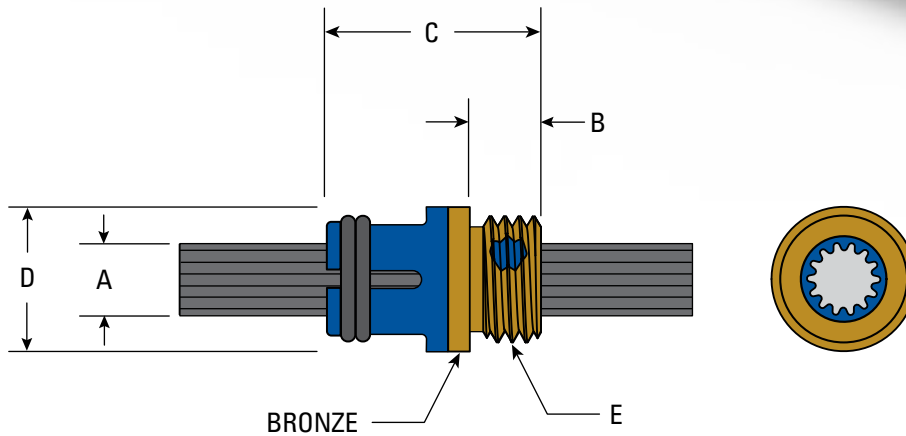
THREAD MOUNT BUSHINGS



SPECIFICATIONS

RAIL DIAMETER	(A) SHAFT DIAMETER	ROOT DIAMETER	EQUIVALENT DIAMETER	(B) THREAD LENGTH	(C) BUSHING LENGTH	(D) BUSHING DIAMETER	(E) MOUNTING THREAD
Tolerances	± .002" [± .05 mm]	"± .002" [± .05 mm]"	"± .002" [± .05 mm]"	± .005" [± .13 mm]"	± .015" [± .38 mm]"	± .001" [± .05 mm]"	
1/4"	0.250"	0.202"	0.226"	0.235"	0.75"	0.500"	7/16-20 UNF
	6.35 mm	5.13 mm	5.74 mm	5.97 mm	19.05 mm	12.70 mm	
3/8"	0.375"	0.306"	0.343"	0.360"	1.00"	0.625"	9/16-20 UN
	9.53 mm	7.77 mm	8.71 mm	9.14 mm	25.40 mm	15.88 mm	
1/2"	0.500"	0.419"	0.460"	0.485"	1.50"	0.813"	3/4-20 UNEF
	12.70 mm	10.64 mm	11.68 mm	12.32 mm	38.10 mm	20.64 mm	

ANTI-BACKLASH BUSHINGS - with thread mount



SPECIFICATIONS

RAIL DIAMETER	(A) SHAFT DIAMETER	ROOT DIAMETER	EQUIVALENT DIAMETER	(B) THREAD LENGTH	(C) BUSHING LENGTH	(D) BUSHING DIAMETER	(E) MOUNTING THREAD
Tolerances	± .002" [± .05 mm]	± .002" [± .05 mm]	± .002" [± .05 mm]	± .005" [± .13 mm]	± .015" [± .38 mm]	± .001" [± .05 mm]	
1/4"	0.250"	0.202"	0.226"	0.235"	0.75"	0.500"	7/16-20 UNF
	6.35 mm	5.13 mm	5.74 mm	5.97 mm	19.05 mm	12.70 mm	
3/8"	0.375"	0.306"	0.343"	0.360"	1.00"	0.625"	9/16-20 UN
	9.53 mm	7.77 mm	8.71 mm	9.14 mm	25.40 mm	15.88 mm	
1/2"	0.500"	0.419"	0.460"	0.485"	1.50"	0.813"	3/4-20 UNEF
	12.70 mm	10.64 mm	11.68 mm	12.32 mm	38.10 mm	20.64 mm	

MACHINED ENDS

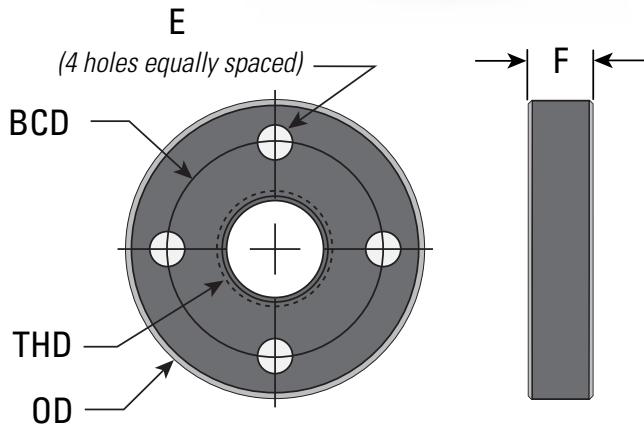
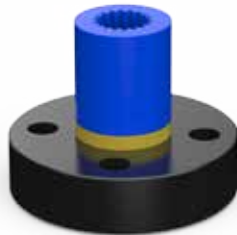
Helix Linear offers complete end machining services. Power Torque Splines can be machined to our standard end configurations or to your custom designs. Below are examples of machined dimensions that can be added to your splines:

- Bearing journals
- Keyways
- Threaded bores
- Flats
- Hexagonal ends
- Cross holes

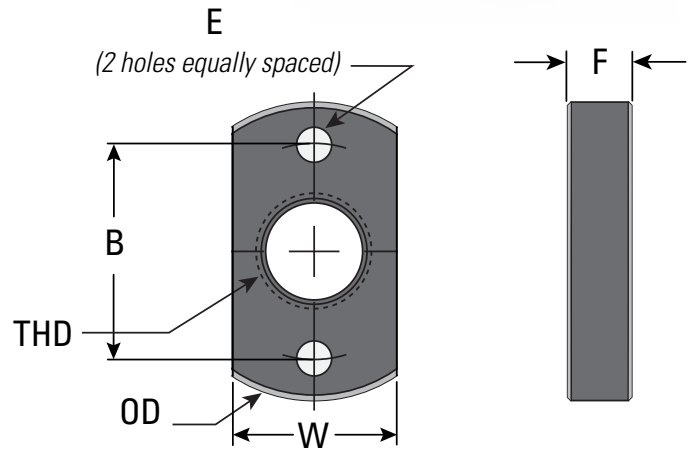
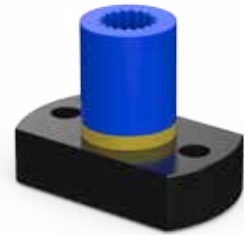


SPLINE FLANGES

Round Flange



Compact Flange



Part Number	OD	E	BCD	F	THD
HFS25	1.21	0.144	0.875	0.250	7/16" - 20 UNF
HFS37	1.46	0.177	1.063	0.375	9/16" - 20 UN
HFS50	1.95	0.266	1.375	0.500	3/4" - 20 UNEF

Part Number	OD	E	B	F	THD	W
HFSD25	1.21	0.144	0.875	0.250	7/16" - 20 UNF	0.670
HFSD37	1.46	0.177	1.063	0.375	9/16" - 20 UN	0.800
HFSD50	1.95	0.266	1.375	0.500	3/4" - 20 UNEF	1.070

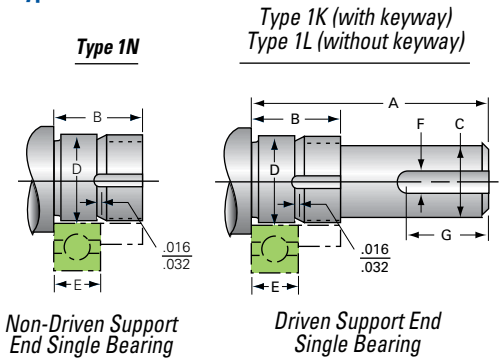
Flanges should be pinned or bonded to nuts to prevent separation during operation.

MACHINED ENDS: Drawing and Codes

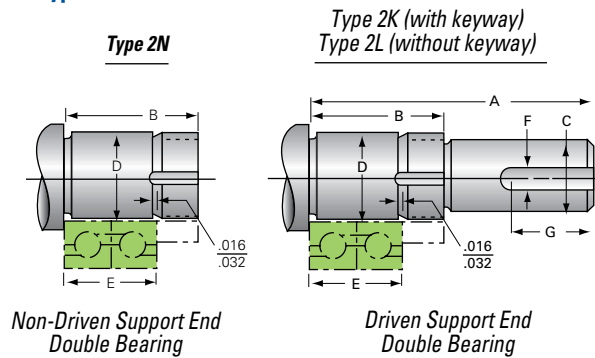
Specifying standard machined ends results in quicker deliveries. The machined ends shown below represent designs that are compatible with common application requirements for either

simple or fixed bearing support. These standard ends may be machined and ground to finish size.

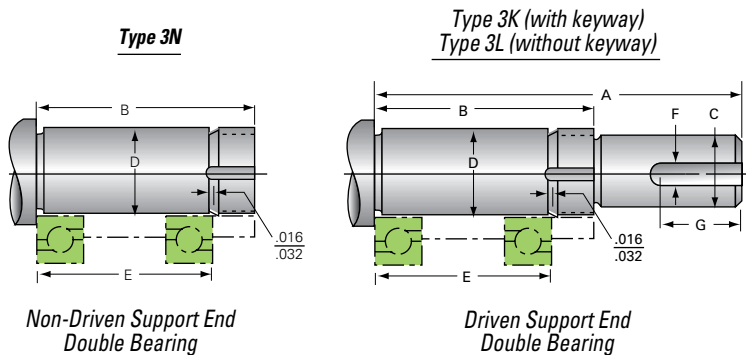
Type 1



Type 2



Type 3



END TYPES

- 1K, 2K, 3K are designed with a shaft extension and keyway for square keys.
- 1L, 2L, 3L are designed with a shaft extension without a keyway.
- 1N, 2N, 3N are designed to be a non-driven support end.
- Double bearing supports use a Type 3N, 3L and 3K.
- Single bearing supports use Type 1N.
- Where standard ends do not satisfy the application requirements, special ends may be machined to customer specifications.

Spline Shaft Diameter	Machined End Code	TYPE 1 (K, L, N) Typical Journal for Single Bearing			TYPE 2 (K, L, N) Typical Journal for Duplexed Bearing			TYPE 3 (K, L, N) Typical Journal for Multiple Sets of Duplexed Bearing			COMMON DIMENSIONS FOR TYPE 1, 2, 3 (K, L, N)				
		A	B	E	A	B	E	A	B	E	C	D	F	G	Locknut
1/2 (0.250")	5	0.88	0.55	0.236	1.09	0.78	0.472	1.56	1.26	0.944	.125/.124	.1970/.1967	N/A	N/A	#10-32
3/8 (0.375")	7	1.12	0.65	0.276	1.41	0.93	0.552	1.94	1.48	1.104	.187/.186	.2757/.2754	0.063	0.34	1/4-20
1/2 (0.500")	9	1.38	0.72	0.315	1.69	1.04	0.63	2.38	1.81	1.438	.250/.249	.3544/.3541	0.094	0.46	5/16-24

* For custom end machining please submit a drawing or model to sales@helixlinear.com for a prompt and competitive quotation.

EZZE-MOUNT UNIVERSAL MOUNT SINGLE AND DOUBLE BEARING SUPPORT



Flanged Mount

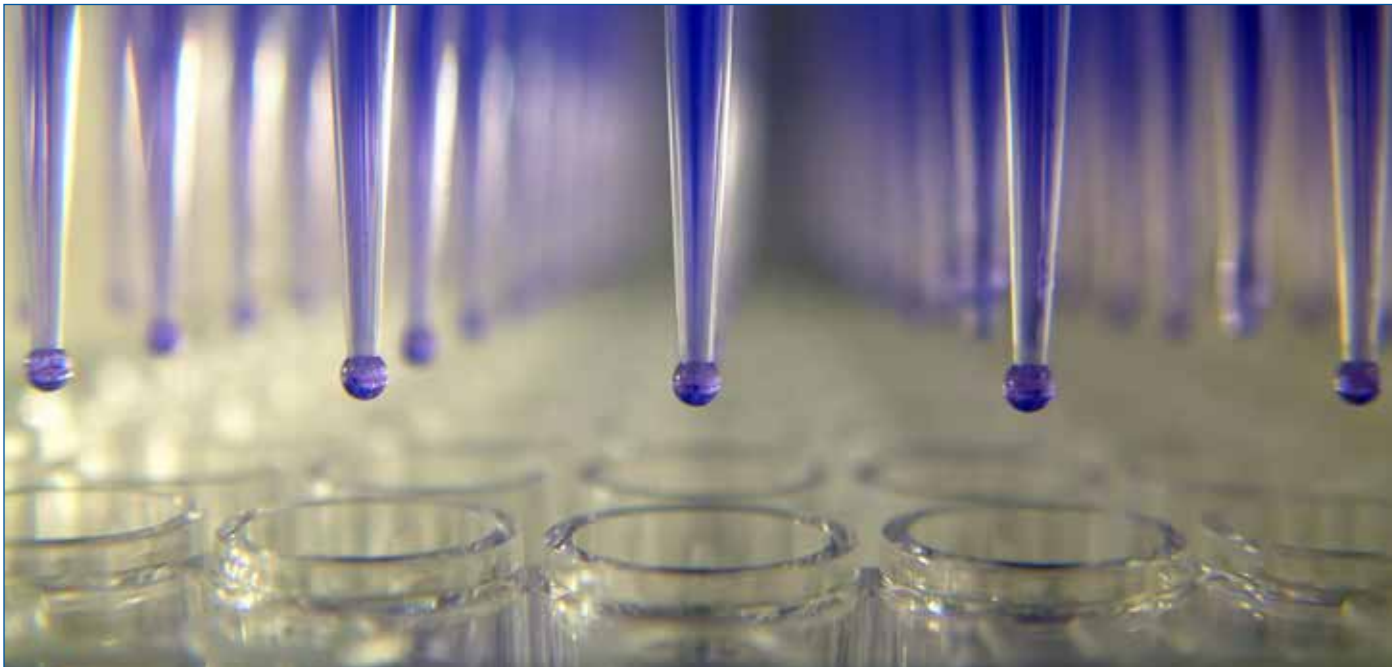


Miniature Universal Mount



Universal Mount

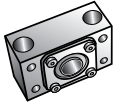
SPLINE 1" DIAMETER	END CODE TYPE	UNIVERSAL MOUNTS		FLANGED MOUNTS	
		Double	Single	Double	Single
1/4" / 0.250"	5	EZM-1005	EZM-4005	EZF-1005	EZF-4005
3/8" / 0.375"	7	EZM-1007	EZM-4007	EZF-1007	EZF-4007
1/2" / 0.500"	9	EZM-1009	EZM-4009	EZF-1009	EZF-4009



Helix Linear precision lead screws are used in a wide array of fluid handling and syringe pump applications.

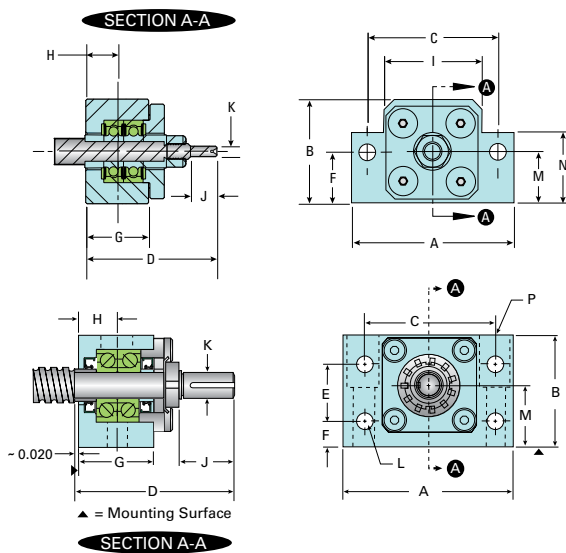
The specifications and data in this publication are believed to be accurate and reliable. However, it is the responsibility of the product user to determine the suitability of Helix products for a specific application. While defective products will be replaced without charge if promptly returned, no liability is assumed beyond such replacement.

EZZE-MOUNT™ UNIVERSAL MOUNT SINGLE AND DOUBLE BEARING SUPPORT



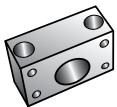
Universal-Mount Double

Double Angular Contact Bearing - use with Type 3 Standard Ends



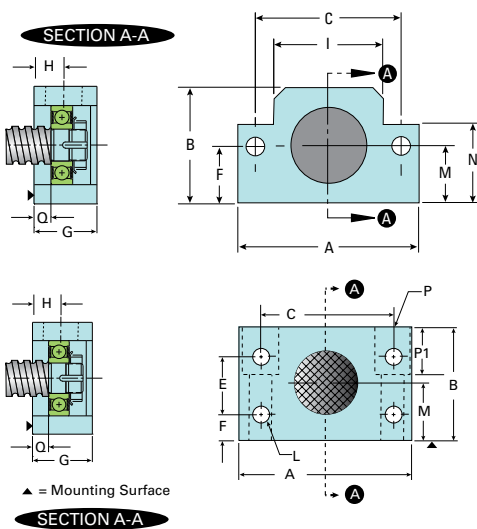
Universal Double Part No.	A	B	C	D	E	F
EZM-1005 (Aluminum)	1.94	1.25	1.56	1.57	-	0.63 (2)
EZM-1005SS (Stainless Steel)	1.94	1.25	1.56	1.57	-	0.63 (2)

Universal Double Part No.	A	B	C	D	E	F
EZM-1007	2.00	1.38	1.50	1.94	0.88	0.25
EZM-1009	2.75	2.00	2.00	2.38	1.38	0.31



Universal-Mount Single

Single Radial Bearing - use with Type 1 Standard Ends



Universal Double Part No.	A	B	C	D	E	F
EZM-4005 (Aluminum)	1.94	1.25	1.56	-	-	0.63 (2)
EZM-4005SS (Stainless Steel)	1.94	1.25	1.56	-	-	0.63 (2)

Universal Double Part No.	A	B	C	D	E	F
EZM-4007	2.00	1.38	1.50	-	0.88	0.25
EZM-4009	2.75	2.00	2.00	-	1.38	0.31

G	H	J	K Shaft Dia.	L Thru	M	Bolt Size	Thru	C'Bore	P1	Q	End Code
0.75	0.38	0.37	0.125 - 0.124	0.20	0.625	#10 (2)	-	-	-	-	5
0.75	0.38	0.37	0.125 - 0.124	0.20	0.625	#10 (2)	-	-	-	-	5

G	H	J	K Shaft Dia.	L Thru	M	Bolt Size	Thru	C'Bore	P1	Q	End Code
1.06	0.50	0.46	0.187 - 0.186	0.22	0.687	1/4 x 1 3/8	0.28	0.41	0.41	--	7
1.19	0.56	0.56	0.250 0.249	0.28	1.000	5/16 x 2	0.34	0.50	0.56	--	9

G	H	J	K Shaft Dia.	L Thru	M	Bolt Size	Thru	C'Bore	P1	Q	End Code
0.75	0.38	-	-	0.20	0.625	#10 (2)	-	-	-	0.13	5
0.75	0.38	-	-	0.20	0.625	#10 (2)	-	-	-	0.13	5

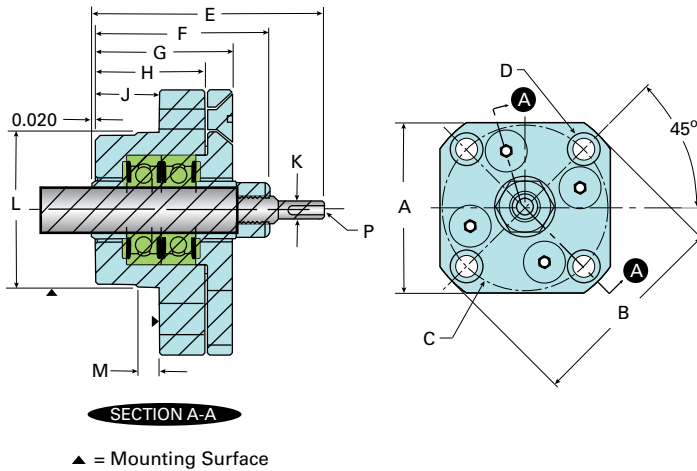
G	H	J	K Shaft Dia.	L Thru	M	Bolt Size	Thru	C'Bore	P1	Q	End Code
1.06	0.50	--	--	0.22	0.687	1/4 x 1 3/8	0.28	0.41	0.41	0.19	7
1.19	0.56	--	--	0.28	1.000	5/16 x 2	0.34	0.50	0.56	0.38	9

The specifications and data in this publication are believed to be accurate and reliable. However, it is the responsibility of the product user to determine the suitability of Helix products for a specific application. While defective products will be replaced without charge if promptly returned, no liability is assumed beyond such replacement.

EZZE-MOUNT™
UNIVERSAL MOUNT SINGLE AND DOUBLE BEARING SUPPORT



Flange-Mount Double
 Double Angular Contact Bearing - use with Type 3 Standard Ends

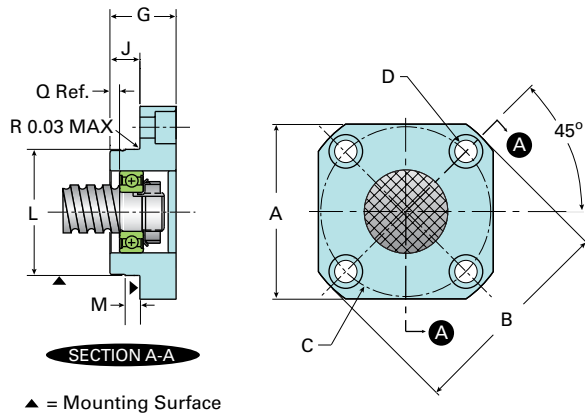


Flanged Double Part No.	A	B	C	D Thru	Counter-bore
EZF-1005 (Aluminum)	1.63	2.00	1.500	0.200	0.38
EZF-1005SS (Stainless Steel)	1.63	2.00	1.500	0.200	0.38

Flanged Double Part No.	A	B	C	D Thru	Counter-bore
EZF-1007	1.88	2.44	1.875	0.266	0.44
EZF-1009	2.00	2.60	2.000	0.266	0.44



Flange-Mount Single
 Single Radial Bearing - use with Type 1 Standard Ends



Flanged Single Part No.	A	B	C	D Thru	Counter-bore
EZF-4005 (Aluminum)	1.63	2.00	1.500	0.200	0.38
EZF-4005SS (Stainless Steel)	1.63	2.00	1.500	0.200	0.38

Flanged Single Part No.	A	B	C	D Thru	Counter-bore
EZF-4007	1.88	2.44	1.875	0.266	0.44
EZF-4009	2.00	2.60	2.000	0.266	0.44

E	F	G	H	J	K Shaft Dia.	L	M	P	Q	End Code
1.58	1.20	0.94	0.75	0.44	0.125-0.124	1.063-1.0625	0.150	-	-	5
1.58	1.20	0.94	0.75	0.44	0.125-0.124	1.063-1.0625	0.150	-	-	5

E	F	G	H	J	K Shaft Dia.	L	M	P	Q	End Code
1.94	1.44	1.06	0.82	0.50	0.187 - 0.186	1.3775 - 1.3770	0.188	0.063	- -	7
2.38	1.81	1.33	1.09	0.71	0.250 - 0.249	1.4957 - 1.4951	0.188	0.094	- -	9

E	F	G	H	J	K Shaft Dia.	L	M	P	Q	End Code
-	-	0.75	-	0.43	-	1.0630-1.0625	0.150	-	0.13	5
-	-	0.75	-	0.43	-	1.0630-1.0625	0.150	-	0.13	5

E	F	G	H	J	K Shaft Dia.	L	M	P	Q	End Code
-	-	1.00	- -	0.40	-	1.3775 - 1.3770	0.188	-	0.13	7
-	-	1.00	- -	0.44	-	1.4957 - 1.4951	0.188	-	0.13	9

LINEAR MOTION APPLICATIONS

High Quality, Precision Linear Motion Solutions

LIFE SCIENCES



- Auto samplers
- Syringe pumps
- Microscopes
- MRI scanners
- CT scanners
- Radiographic machines
- In-vitro diagnostics
- Genomics
- Blood gas chemistry

PRINTING & BINDING



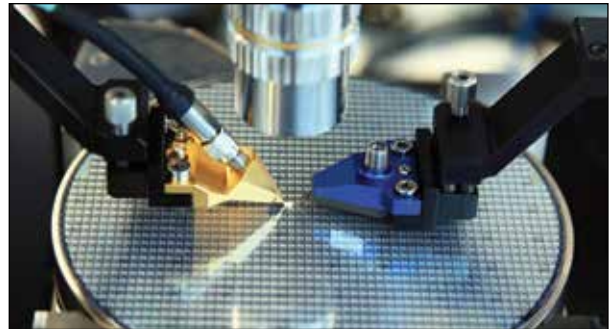
- "Z" axis actuators
- Multi-axis gantries
- 3D printing
- Automation / Material handling
- Additive manufacturing (AD)
- Large format sign printing
- Digital offset printing process
- Folding and sealing equipment
- Thermal CTP systems

SECURITY - MILITARY



- Automated door locking systems
- Pan-tilt-zoom cameras
- Automated gates
- Tactical automated security cameras
- Missile fin actuation
- Tank sighting systems
- Drones and UAVs
- Torpedo fin actuation
- Guided munitions

SEMICONDUCTOR



- Burnishing stages
- Stacking systems
- Vision inspection machines
- X, Y, Z gantries
- Wafer elevators / Wafer handling
- Acoustic microscopes
- Ultrasonic imaging
- Tuning coils
- Vacuum chamber doors