MINIATURE PRECISION TORQUE SPLINES

helixlinear.com
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.
OVERTURNING LOAD

Straightness tolerances can be expected. Precision Torque™ splines with machined ends from Helix Linear may require additional straightening when ordered. When ordering random lengths or cut material without end machining, straightening may cause the material to bend. Before, during and after machining, 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 valve.

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.

MATERIAL SPECIFICATIONS

Precision Torque™ bushings are made of high-strength bronze and Helix brand high-load composite polymer.

FEATUERES 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.

SPLINE TERMS

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).

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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)

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 valve. 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.

PLATE ORDERING GUIDE TABLE

<table>
<thead>
<tr>
<th>Splines Shaft Diameter</th>
<th>Number of Teeth</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.250” (6.35mm)</td>
<td>14</td>
</tr>
<tr>
<td>0.375” (9.52mm)</td>
<td>16</td>
</tr>
<tr>
<td>0.625” (15.87mm)</td>
<td>18</td>
</tr>
</tbody>
</table>

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 Torque™ 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.

LOAD DEFINITIONS

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

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

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

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

<table>
<thead>
<tr>
<th>Bushing Style</th>
<th>Spline Diameter</th>
<th>Mounting</th>
<th>Number of bushings per spline</th>
<th>Coating Type</th>
<th>Length</th>
</tr>
</thead>
<tbody>
<tr>
<td>PTS Standard Bushing</td>
<td>04 1/4&quot;</td>
<td>T Round Flanged</td>
<td>01</td>
<td>HX4 Helix PTFE</td>
<td>10.00</td>
</tr>
<tr>
<td>PTA Anti-backlash Bushing</td>
<td>08 1/2&quot;</td>
<td>P Plain Mount</td>
<td>01</td>
<td>H4X Black Diamond</td>
<td>10.00</td>
</tr>
</tbody>
</table>

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## Cylinder Mount Bushings

**Specifications**

<table>
<thead>
<tr>
<th>Rail Diameter</th>
<th>(A) Shaft Diameter</th>
<th>Root Diameter</th>
<th>Equivalent Diameter</th>
<th>(B) Mounting Surface Length</th>
<th>(C) Bushing Length</th>
<th>(D) Bushing Diameter</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/4&quot;</td>
<td>± .002&quot; [± .05 mm]</td>
<td>&quot;± .002&quot;</td>
<td>&quot;± .005&quot;</td>
<td>&quot;± .015&quot;</td>
<td>&quot;± .001&quot;</td>
<td></td>
</tr>
<tr>
<td></td>
<td>0.250&quot;</td>
<td>0.202&quot;</td>
<td>0.226&quot;</td>
<td>0.325&quot;</td>
<td>0.75&quot;</td>
<td>0.500&quot;</td>
</tr>
<tr>
<td>3/8&quot;</td>
<td>0.375&quot;</td>
<td>0.306&quot;</td>
<td>0.343&quot;</td>
<td>0.333&quot;</td>
<td>1.00&quot;</td>
<td>0.625&quot;</td>
</tr>
<tr>
<td>1/2&quot;</td>
<td>0.500&quot;</td>
<td>0.419&quot;</td>
<td>0.460&quot;</td>
<td>0.625&quot;</td>
<td>1.50&quot;</td>
<td>0.813&quot;</td>
</tr>
<tr>
<td></td>
<td>12.70 mm</td>
<td>10.64 mm</td>
<td>11.68 mm</td>
<td>15.88 mm</td>
<td>38.10 mm</td>
<td>20.64 mm</td>
</tr>
</tbody>
</table>

**Tolerances**

- ± .002" [± .05 mm]
- "± .002" [± .13 mm]
- "± .015" [± .38 mm]
- "± .001" [± .05 mm]

## Thread Mount Bushings

**Specifications**

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<tr>
<th>Rail Diameter</th>
<th>(A) Shaft Diameter</th>
<th>Root Diameter</th>
<th>Equivalent Diameter</th>
<th>(B) Thread Length</th>
<th>(C) Bushing Length</th>
<th>(D) Bushing Diameter</th>
<th>(E) Mouting Thread</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/4&quot;</td>
<td>± .002&quot; [± .05 mm]</td>
<td>&quot;± .002&quot;</td>
<td>&quot;± .005&quot;</td>
<td>&quot;± .015&quot;</td>
<td>&quot;± .001&quot;</td>
<td>7/16-20 UNF</td>
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<tr>
<td></td>
<td>0.250&quot;</td>
<td>0.202&quot;</td>
<td>0.226&quot;</td>
<td>0.325&quot;</td>
<td>0.75&quot;</td>
<td>0.500&quot;</td>
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<tr>
<td>3/8&quot;</td>
<td>0.375&quot;</td>
<td>0.306&quot;</td>
<td>0.343&quot;</td>
<td>0.333&quot;</td>
<td>1.00&quot;</td>
<td>0.625&quot;</td>
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<tr>
<td>1/2&quot;</td>
<td>0.500&quot;</td>
<td>0.419&quot;</td>
<td>0.460&quot;</td>
<td>0.625&quot;</td>
<td>1.50&quot;</td>
<td>0.813&quot;</td>
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<tr>
<td></td>
<td>12.70 mm</td>
<td>10.64 mm</td>
<td>11.68 mm</td>
<td>15.88 mm</td>
<td>38.10 mm</td>
<td>20.64 mm</td>
<td></td>
</tr>
</tbody>
</table>

**Tolerances**

- ± .002" [± .05 mm]
- "± .002" [± .13 mm]
- "± .015" [± .38 mm]
- "± .001" [± .05 mm]
ANTI-BACKLASH BUSHINGS - with thread mount

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

MACHINED ENDS

SPLINE FLANGES

Round Flange

Compact Flange

Flanges should be pinned or bonded to nuts to prevent separation during operation.
MINIATURE PRECISION TORQUE SPLINES

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 1N** (without keyway)
- **Type 1L** (with keyway)
- **Type 1K** (with keyway)

### Type 2

- **Type 2N** (without keyway)
- **Type 2L** (without keyway)
- **Type 2K** (with keyway)

### Type 3

- **Type 3N** (without keyway)
- **Type 3L** (without keyway)
- **Type 3K** (with keyway)

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.**

### End Types

- **Type 1 (K, L, N)**
- **Type 2 (K, L, N)**
- **Type 3 (K, L, N)**

**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.**

### Machine Ends - EZZE-MOUNT™

**MACHINED ENDS - EZZE-MOUNT™**

EZZE-MOUNT UNIVERSAL MOUNT SINGLE AND DOUBLE BEARING SUPPORT

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

**Helix Linear**

2018 Commerce Park Road | Beachwood, OH 44122 USA | 216-485-2232 or 1-855-435-4958 | email: sales@helixlinear.com

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

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**EZZE-MOUNT UNIVERSAL MOUNT SINGLE AND DOUBLE BEARING SUPPORT**

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<tr>
<th>DIAMETER</th>
<th>END CODE TYPE</th>
<th>UNIVERSAL MOUNTS</th>
<th>FLANGED MOUNTS</th>
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<td>1/4&quot; / 0.250&quot;</td>
<td>5</td>
<td>EZM-1005</td>
<td>EZM-4005</td>
</tr>
<tr>
<td>5/32&quot; / 0.375&quot;</td>
<td>7</td>
<td>EZM-1007</td>
<td>EZM-4007</td>
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<tr>
<td>1/4&quot; / 0.500&quot;</td>
<td>9</td>
<td>EZM-1009</td>
<td>EZM-4009</td>
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</table>

9
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### Universal-Mount Double
Double Angular Contact Bearing - use with Type 3 Standard Ends

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<tr>
<td>EZM-1005 (Aluminum)</td>
<td>1.94</td>
<td>1.25</td>
<td>1.56</td>
<td>1.57</td>
<td>-</td>
<td>-</td>
<td>0.63 (2)</td>
<td>0.75</td>
<td>0.38</td>
<td>0.37</td>
<td>0.125 - 0.124</td>
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<td>0.625</td>
<td>#10 (2)</td>
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<tr>
<td>EZM-1005SS (Stainless Steel)</td>
<td>1.94</td>
<td>1.25</td>
<td>1.56</td>
<td>1.57</td>
<td>-</td>
<td>-</td>
<td>0.63 (2)</td>
<td>0.75</td>
<td>0.38</td>
<td>0.37</td>
<td>0.125 - 0.124</td>
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<td>#10 (2)</td>
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<tr>
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### Universal-Mount Single
Single Radial Bearing - use with Type 1 Standard Ends

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<tr>
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<td>-</td>
<td>0.63 (2)</td>
<td>0.75</td>
<td>0.38</td>
<td>-</td>
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<td>0.20</td>
<td>0.625</td>
<td>#10 (2)</td>
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<td>0.13</td>
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<td>-</td>
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<tr>
<td>EZM-4009</td>
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<td>2.00</td>
<td>-</td>
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<td>0.31</td>
<td>1.19</td>
<td>0.56</td>
<td>-</td>
<td>-</td>
<td>0.28</td>
<td>1.000</td>
<td>9/16 x 2</td>
<td>0.34</td>
<td>0.50</td>
<td>0.56</td>
<td>0.38</td>
<td>9</td>
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</tbody>
</table>
**Flange-Mount Double**
Double Angular Contact Bearing - use with Type 3 Standard Ends

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<tbody>
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<td>0.150</td>
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<td>EZF-1005SS (Stainless Steel)</td>
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<td>1.58</td>
<td>1.20</td>
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<td>0.75</td>
<td>0.44</td>
<td>0.125-0.124</td>
<td>0.1063-0.10625</td>
<td>0.150</td>
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| Flange-Mount Single**
Single Radial Bearing - use with Type 1 Standard Ends

<table>
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<tr>
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<td>0.43</td>
<td>–</td>
<td>1.0630-1.0625</td>
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<td>0.38</td>
<td>–</td>
<td>–</td>
<td>0.75</td>
<td>–</td>
<td>0.43</td>
<td>–</td>
<td>1.0630-1.0625</td>
<td>0.150</td>
<td>0.13</td>
<td>5</td>
</tr>
</tbody>
</table>

| EZF-4007 | 1.80 | 2.44 | 1.875 | 0.266  | 0.44 | –   | –   | 1.00 | –   | 0.40         | –   | 1.3775-1.3770 | 0.188 | –   | 0.13 | 7       |          |
| EZF-4009 | 2.00 | 2.60 | 2.000 | 0.266  | 0.44 | –   | –   | 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

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