

# igus® Tech Talk

## Overview: Tribo-polymer Lead Screw Nuts

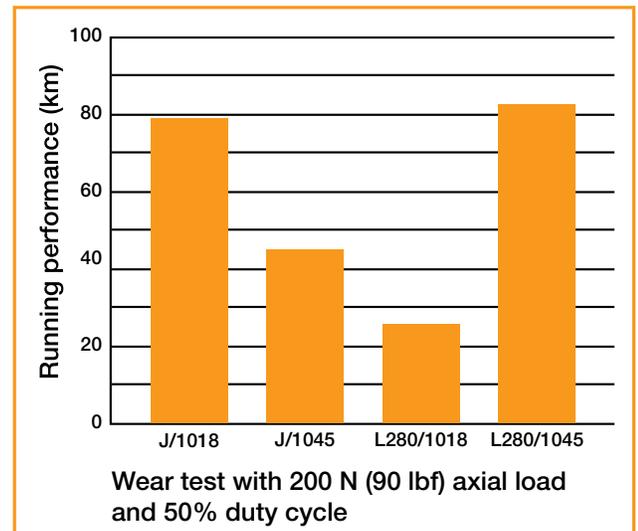
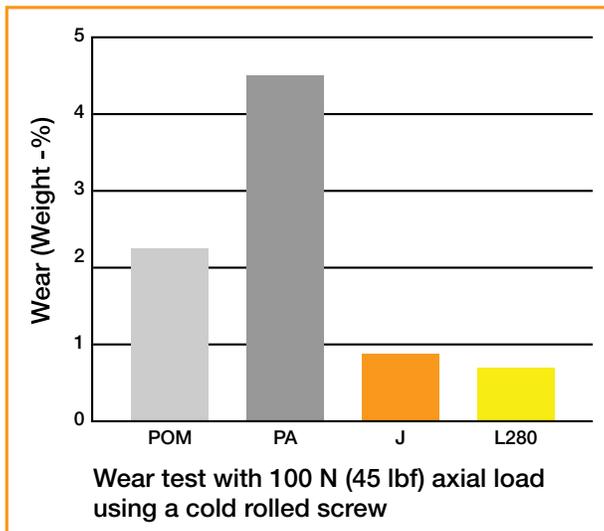
### Convert rotary motion into linear motion

Matt Mowry  
Product Manager



Lead screws are a common technology used to convert rotary motion into linear motion, and are often used to provide actuation to a set of linear bearings. Plastic lead screw nuts are an excellent alternative to ball screws in many applications where extreme precision (micron level) is not required. They require no external lubricant, which makes them suitable in applications ranging from sensitive lab instruments to packaging machines. Trapezoidal lead screws are ideal for 3D printers, as the industry is standardized on metric motion profiles and components. They are also very easy to customize, and are found in a number of geometries, from coarse threads for higher torque output, to high-helix designs for higher speed applications.

Traditional materials for lead screw nuts are typically brass, oil-impregnated bronze, and simple plastic materials. igus® tribo-plastics, such as iglide® J and iglide® L280 are composite plastic materials, which offer lower friction and wear values than many other materials across a whole range of applications. These composites operate free of any oil and grease, and do not require maintenance. They are able to operate on traditional ferrous lead screws, as well as low-weight aluminum lead screws.



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### ACME and Trapezoidal Lead Screws

The single-start ACME thread is the most common form of the lead screw nut in North America. Developed in the mid-1800s, they can be found on all types of machines, and are most suited to low-cycle or positioning applications. Their trapezoidal shape makes them better suited for the axial loading found in power transmission applications.

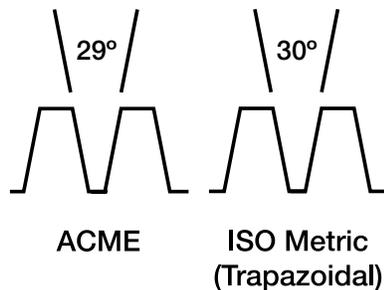
Standards for single-start ACME nuts apply to the inner thread dimensions. ACME lead screws are called out by their diameter, and then the threads-per-inch (TPI). For example:

**A ¾-20 ACME has a major ID of 0.75" and 20 TPI**

To calculate the lead (linear travel in inches per one screw revolution) simply divide 1 inch by the TPI. In the above example a 20-TPI nut will travel 0.05" per one revolution.

Trapezoidal lead screws, sometimes referred to as "metric ACME", are almost identical to ACME lead screw forms, and are more commonplace in Europe and Asia. The major difference from regular ACME is that they are based on metric dimensions, and the angle differs by 1°.

#### Common CNC Drive Forms



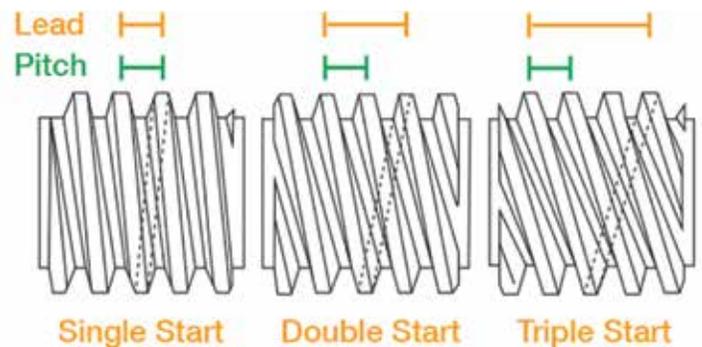
Trapezoidal screws are generally covered by ISO standards for inner and outer geometry. Unlike ACME, they are specified by their major inner-diameter (in mm), and then their pitch (in mm). For example, a trapezoidal 10mm ID screw with a 2mm pitch is called out by:

**TR 10 x 2**

It is important to note that we have been discussing single-start screws. This means that there is one continuous thread on the individual screw. Many manufacturers offer multi-start ACME screws, but the geometries are not necessarily compatible from one manufacturer to another. Multiple-start lead screws benefit from higher load capabilities compared to single-start screws. However, they lose their mechanical advantage, meaning they require higher input torque than single-start screws.

### Lead vs. Pitch

In single-start geometries, the lead and pitch of a nut are identical. On the other hand, in multi-start leads, the lead is generally greater than the pitch, as shown in the drawing below:



### Self-Locking and Back-Driving

One important feature of single-start ACME or Trapezoidal systems is that they are not back-drivable. This means they will not convert thrust loads (like gravity) into torque loads. In other words, they will not fall under their own weight; instead, the screw must be turned for the system to move. In many applications, this may eliminate the need for a motor brake, and holding torque requirements on the motor may be reduced in some applications - a major benefit over other types of actuators.



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### Backlash

Since lead screw nuts glide instead of roll, there is an inherent amount of axial clearance between the screw and the nut. This clearance must be overcome by the screw before its engagement with the nut provides linear motion. This means there is additional tolerance in the rotation of the screw as it translates to linear positioning. Companies such as igus® have developed solutions to remove or reduce this backlash completely.

### Zero and Anti-Backlash Lead Screw Nuts

igus® offers zero-backlash nuts for its dryspin® high-helix family of products, as well as anti-backlash nuts for its Trapezoidal (metric ACME) nuts. Zero-backlash assemblies employ two nuts, which are forced apart from each other through the use of a torsion spring. This takes up the axial clearance, providing compensation throughout the lifetime of the system. The anti-backlash nut is designed with a small secondary section in the ID of the nut, which preloads the system, helping to reduce clearance.

#### Zero-backlash nut for dryspin® high-helix screws

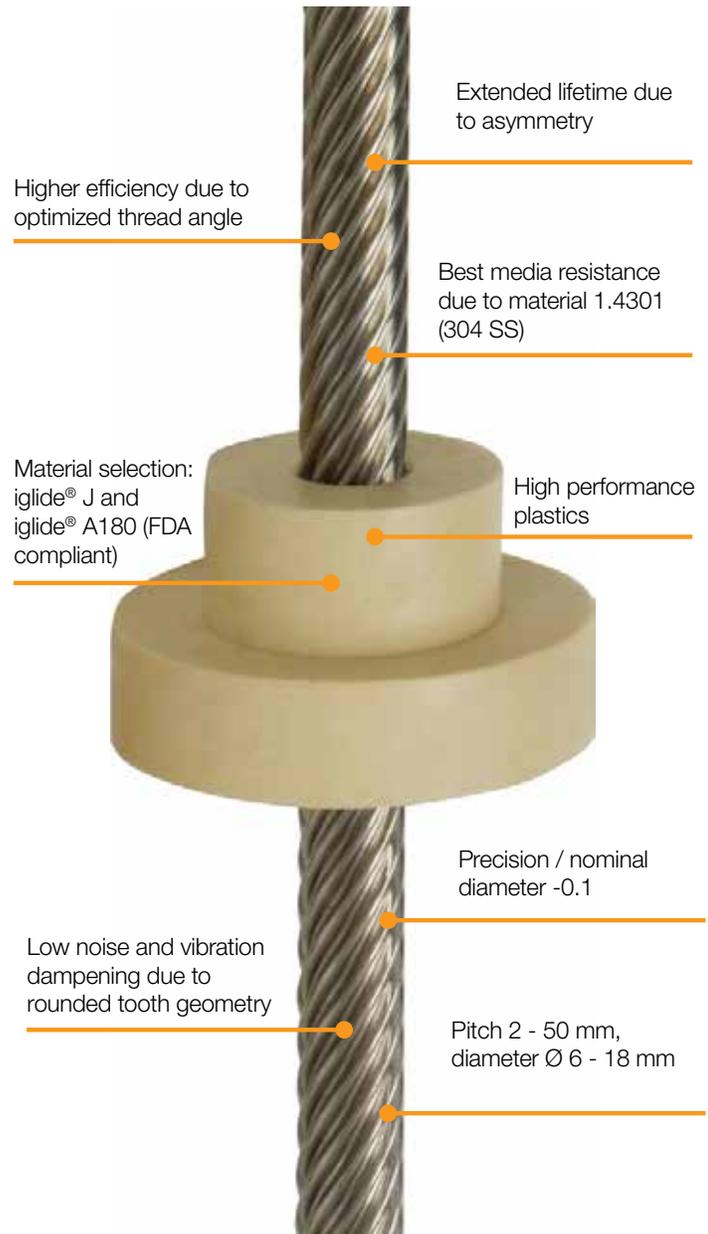


#### Preloaded nut for Trapezoidal (metric ACME) Screws



### High-Helix dryspin® Technology

igus® developed a new high-helix geometry for higher speed applications. While ACME and Trapezoidal lead screw systems are good for positioning high loads, these high-helix threads are better suited for high cycles and speeds, but are also ideal for low load applications. The screws were designed asymmetric to the plastic nuts, optimizing the load carrying areas of the nuts to reduce surface pressure, which in turn increases service life.



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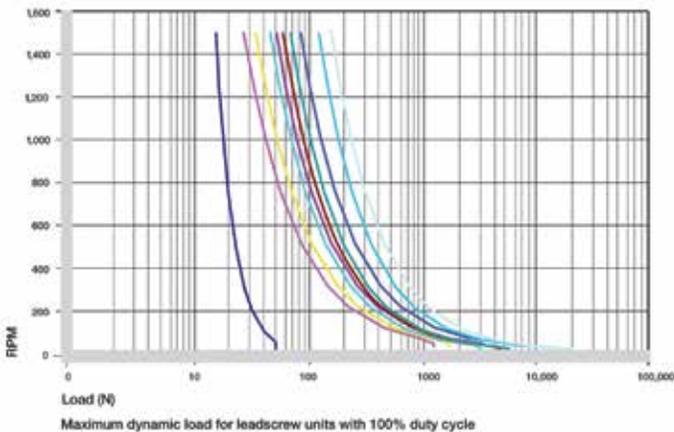
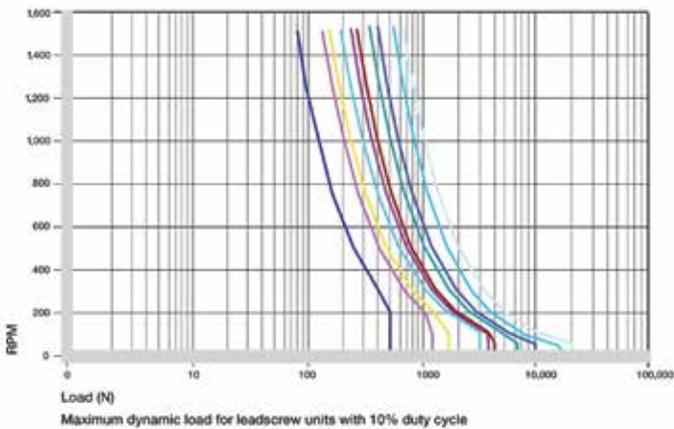
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### Load. Speed. Lifetime.

Typical loads for igus® ACME and Trapezoidal threaded nuts are higher than for high-helix, as is represented in the graphs below. Static loads up to 28,900 N (6,502 lbf) are possible with larger diameter screws.

High-helix lead screw systems are capable of loads up to 1,285N (291 lbf).

**Reference values when using DryLin® plastic nuts without lubrication (with stroke 500 mm). A compensation factor must be used with very short or very long strokes.**



- TR8x1.5
- TR10x2
- TR12x3
- TR16x4
- TR18x4
- TR20x4
- TR24x5
- TR30x6
- TR40x7
- TR50x8

### Application Examples

Lead screws are used in a multitude of industries and applications including laboratory equipment, packaging, 3D printing, and automation machinery, as well as fitness equipment and aircraft interiors.

3D Printing: igus® Trapezoidal lead screws work well in 3D printing environments, and are resistant to many contaminants that are attracted to oiled nuts. Nearly all 3D printers are programmed and built around metric components, so they are a natural fit.



### 3D Printing

igus® gives designers of 3D printers access to a wide variety of linear technology, plain bearings, energy supply chains and lead screw units

Learn more:  
[igus.com/3Dprinting](https://igus.com/3Dprinting)

Lab Machinery: igus® high helix lead screws are ideal in sensitive lab environments, especially due to their lack of lubricants around scientific specimens.



Two component mixing unit



Laser marking unit



Can opener: drive adjustment



Lab equipment: liquid handling

### More information

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Lead screw nut in block valve



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