

Lead Screw Technology Rolls Over Ball Screw

Lead screws were once believed to be a cheap substitute for ball screws, to be used in less demanding applications. They were often assembled using low quality screws from ball screws or fastener designs, where a simple, one-piece nut provided basic power transmission and rotary-to-linear motion conversion.

Today, lead screws offer the latest technology for motion control, with many distinct advantages. Lead screws differ from ball screws through the use of sliding, rather than rolling, friction between the nut and screw. Modern materials allow us to keep friction very low (less than 0.10) without any external lubrication.

Some of the key advantages are:

- Zero maintenance
- No lubrication required
- Lower particulate generation
- Longer life with non-catastrophic failure
- Quieter operation (no re-circulating ball noise)
- High helix/Fast leads (greater than 100mm/rev)
- Very fine threads (as small as 0.5mm/rev)
- Non-backdriving (self-locking) leads
- Multi-function nuts
- Easily customized nut designs
- Zero-backlash with very light pre-load/low drag
- Much lower cost/selling price – 25 to 90% less!

We build on these lead screw advantages. Using both patented and proprietary technology, we offer the additional benefits:

- Precision thread rolling offers lead accuracy of .0001 mm/mm at approximately one tenth the cost of ground screws and lengths up to 4 meters.
- Polymer composite nut materials that provide high strength (dynamic loads of 250 kg.), long life (over 750 million cm. of travel) while being molded to custom shapes to provide additional functionality.
- Anti-backlash nut designs that automatically compensate for wear.

When should ball screws be used? If the application can tolerate the high cost, the design limitations, the noise and the reduced life, the best *ground* ball screws offer greater maximum speed, lead accuracy and load capability.

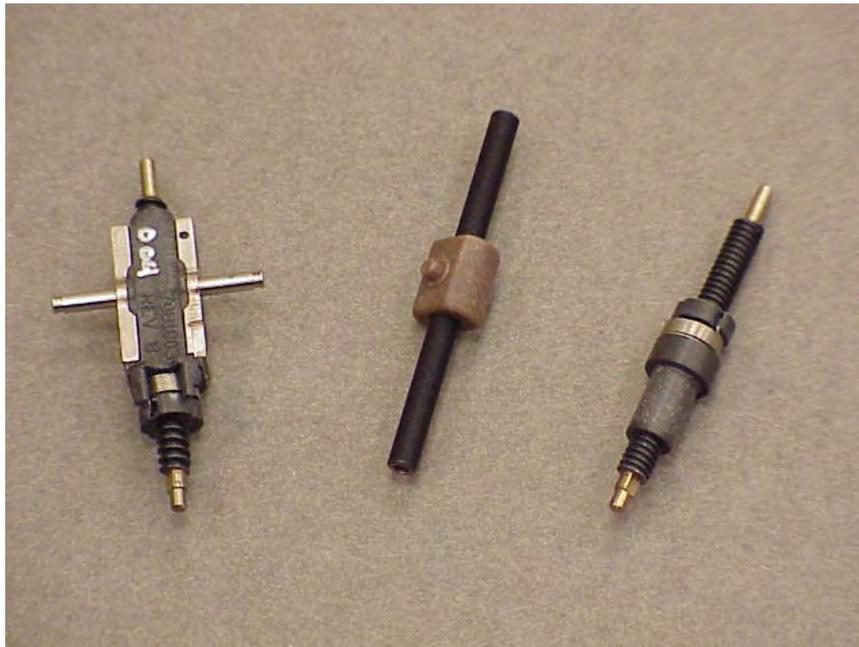
Due to the mechanics of rolling elements, ball screws have higher theoretical efficiencies than lead screws with their sliding elements. In practice, the differences are often smaller because of the effects of lubricant viscosity and manufacturing tolerances. It is these same efficiencies that prevent ball screws from offering self-locking, non-backdriving leads. Rolled ball screws are less expensive than ground ball screws but have compromises that reduce these advantages. The user gets a high load rating but is left with a higher maintenance component, shorter life and less design flexibility, that may still costs several times more than a precision rolled lead screw assembly.

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Top quality lead screws outperform both inexpensive lead screws and more expensive ball screws. They also cost less to use. Lead screws are an enabling technology. Without them some products would never make it to market. Here are some examples.

Lead screws work well in wash down environments. The materials used and the lubricant-free operation allows total immersion in water, or many other fluids.

Miniature lead screws, with and without antibacklash compensation provide precision motion in a package size unmatched by other technologies. The ability to produce a high accuracy screw and nut, 2 to 4 mm in diameter, with custom features has succeeded in bringing the latest data storage drives and telecommunications equipment to market.



The screws shown here are all less than 80mm long, with both right-hand and left-hand threads, and leads as fine as 0.65mm.

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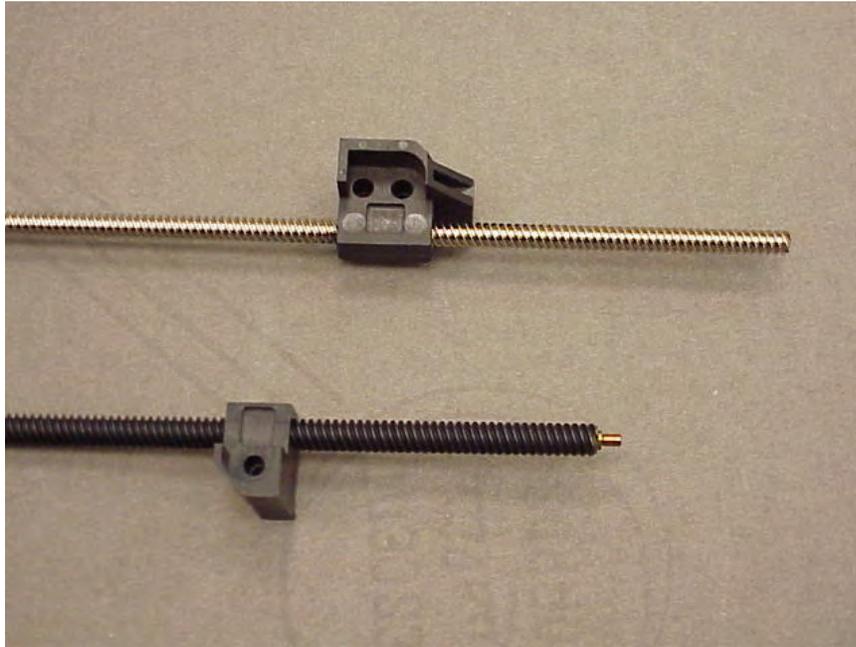
At the other end of the spectrum, lead screws can have very fast leads, up to 100mm/rev so far, that are efficient and accurate. This type of thread has been very successful in high-speed automation, including semiconductor handling, laser scanning and engraving, transportation door actuation and valve actuation.



These screws, with leads of more than 75mm/rev and diameters of 20 to 25mm can be readily supplied in lengths over 4 meters! This would be impossible for a ball screw. Thread grinding cannot produce these high-helix leads and the cost of a 4 meter ground screw would be huge. Yet the best lead screws are produced in many leads with standard accuracy of 0.0006 mm/mm and special accuracy to 0.0001mm/mm. Rolled multi-start threads also avoid thread drunkenness caused by pitch-to-pitch error of ground or cut multi-start threads.

High helix, fast leads are possible in smaller diameters as well. We produce screws of 3mm diameter with leads of 10mm/rev. Screws with 6mm diameter and 25mm/rev leads are very popular in all types of equipment, including printing and scanning, data storage, medical analysis, paper handling, semiconductor handling and light industrial applications.

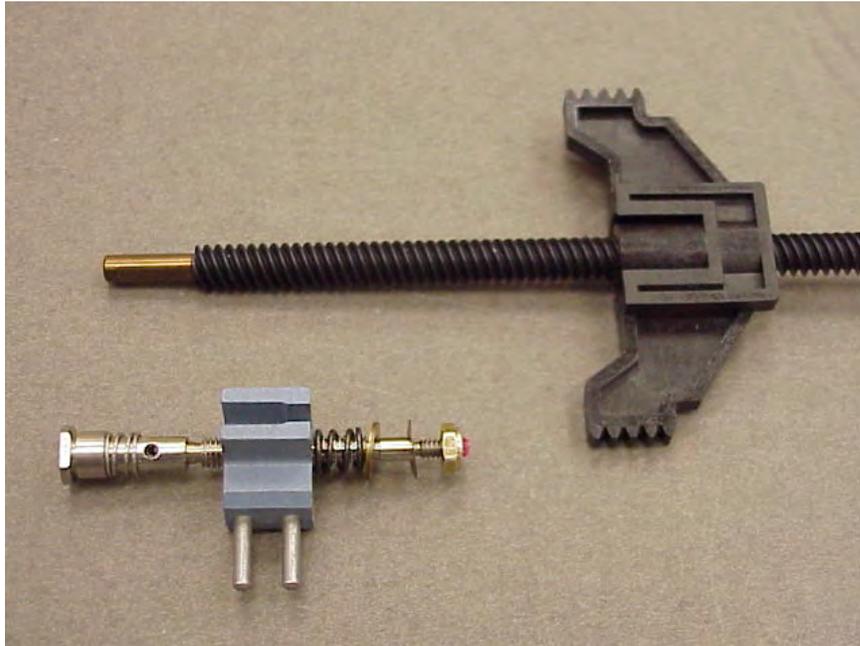
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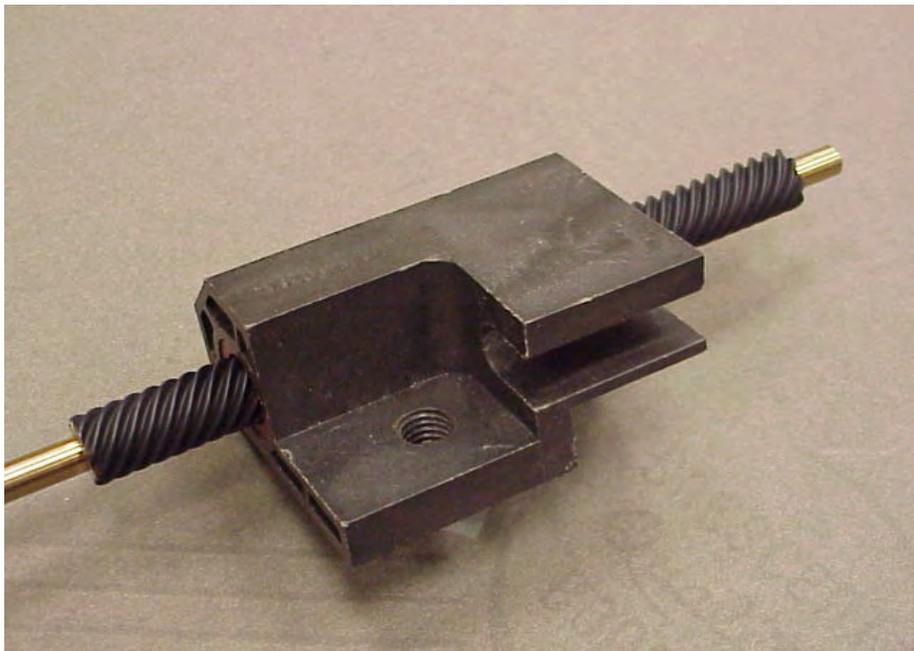
Here are some fast lead screws used in data storage systems. These are 4 and 6mm diameter. Notice also the complex precision molded nuts. These nuts have added functions that reduce part count, reduce tolerance stack-up, outlive, outperform and reduce overall product cost compared to more expensive ball screws and less expensive competitors' lead screws.

The benefit of multifunction, custom-molded lead nuts is great. Using a variety of materials, lead screws offer higher performance at lower costs. Some additional examples of multifunction nuts follow. Imagine how many parts would be needed to perform the functions if only a standard nut configuration was available. Then, try to imagine getting this type of customization in a ball nut!

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Complex assemblies are reduced to single components. Complete solutions are custom engineered and delivered at a lower cost, and usually in less time, than standard offerings from competitive technologies.



Here, the nut incorporates the carriage and linear guide block. Although this is a high value lead screw, the customer sees reduced component costs and a dramatic simplification of assembly and alignment.