Lead Screws Q&A – Application Considerations

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When considering lead screws, what specifications are most important to look at?

Lead screw performance is largely a factor of axial load and rotational speed (rpm). The relationship between the two is governed by the "Pressure Velocity" or PV curve.

Because lead screws operate using sliding surfaces to support the loads, friction generated heat is created. Wear also occurs between these surfaces. The PV curve defines the safe operating limits of load and speed. As load increases, the rotational speed must be reduced to prevent excessive heating and wear from occurring. The reverse is also true. So it is possible to turn the screw at high speed while applying a light load or move slowly under a heavier load. It should be noted that the travel per revolution can be increased to increase the linear speed without increasing the required rpm. This is a good way to increase the life of a lead screw.

In order to size a lead screw system it is important to know what torque will be required to drive the load. This can be calculated simply once the efficiency if the lead screw is known. The more travel per revolution, the higher the required torque but the efficiency also increases (up to a point).

What are the main differences between lead screws and ACME screws?

"Lead screw" is a generic term. It refers to any threaded drive screw using sliding surfaces to transmit the load. Lead screws are typically used for dynamic applications. Static applications are generally referred to as fastener screws and utilize inefficient thread forms not well suited for regular motion.

"ACME" is a term that refers to a particular thread form. An ACME screw is also a lead screw but not the reverse. The ACME thread standard was designed for part interchangeability and is accompanied by specific class such as 2G, 3G, 2C etc. These have slightly different tolerances. ACME thread forms can be easily checked using readily available thread gauges (plug and ring.) However, ACME thread is designed for interchangeability and manufacturability. Other proprietary lead screw thread forms may perform better depending on the application but are more difficult to characterize.

What are the main differences between the design arrangements of English and metric? In what types of situations/applications would each be used?

Lead screws are produced in both inch and metric sizes. The inch standard is ACME and the metric standard is Trapezoidal. The thread forms are very similar between the two and there is no significant advantage in performance of one over the other. The choice of an inch or metric product generally comes down to two issues: what is the most ideal lead (travel per revolution) for my application and what units are native to the equipment I'm designing. In many cases, the selection of inch or metric depends simply on lead availability. Once the lead constant is entered in the control system, there is little difference whether the screw is inch or metric.

What sort of applications would lead screws be used in?

Lead screws are often used in instrument grade applications where smooth, precise, clean and maintenance free operation is required. The nut material is typically made of internally lubricated polymer. Some examples would be laboratory and life sciences equipment such as DNA sampling, scanning and fluid handling devices. Other applications include engraving, rapid prototyping, inspection, and data storage. Lead screws are also used in heavy lifting applications when combined with a metallic (typically bronze) nut.

What needs to be considered when deciding among rolled, milled, or ground manufacturing processes?

Rolling is preferred over cutting (turning on a lathe) for lead screws. It results in a harder surface with superior surface finish. It can be used to fabricate long bars of material which can be cut to any length. Lead accuracy can be held to better than .003 inch/foot. If higher accuracy is required, grinding should be considered. The grinding process can hold lead accuracy's as tight as .0003 inch/foot or better. However, this process is much more expensive (10x).

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