Q&A Session for Lead Screws 101: Basics for Design Engineers

Q: Does the order in the picture correspond to the fixity diagram?
A- The figure on the left from top to bottom – fixed-free, simple-simple, fixed-simple, and fixed-fixed. The picture on the right from left to right – simple-simple, fixed-fixed, fixed-simple, and fixed-free.

Q: What is typical “wobble” between the screw and the nut? Where would it be specified? We use SRA4-2516 with XCT4-2516 nut.
A- This is not specified in the catalog but typical runout of the external mounting thread to the internal ball form is within .005 inches for this size assembly.

Q: What causes some squeaking/squealing noise between screw and nut and how can it be minimized or eliminated?
A- The noise from a lead screw is typically a combination of material, alignment, and system orientation. The exact cause of noise in an individual system must be determined on a case by case basis because of the combination of variables. Possible solutions can range from modifications to system speed, improved alignment, and vibration control.

Q: What’s a typical COEF to use for design?
A- Typical coefficients of friction of linear motion products are: .001 for ball bushings, .005 for profile rail, .01 for a cam follower, and .15 for plain bearings based on proper lubrication.

Q: What is the reason for the reduced vibration of the lead screw (no ball circulation?)
A- The vibration due to ball recirculation is very small but in some applications even this small amount may be an issue (i.e. medical imaging). Other sources of system vibration may be caused by journal runout, screw straightness, or screw length.

Q: What would you recommend for an application that does not need much accuracy (lift a load in a vertical direction from one position to another)
A- Depending on the load and speed, a lead screw or rolled ball screw would be the products of choice.

Q: What are general guidelines for adjusting the tension of the backlash reducing nut?
A- This is dependent on the model of the lead nut and should be set at the factory initially.

Q: What are typical minimum volumes for customizing a motor with lead screw or a nut?
A- Quantities in excess of 500 units per year are recommended but may be as low as 100 units per year in special circumstances. Please contact a Thomson application engineer to discuss your application if you fall in the gray area.

Q: Can 1 micron repeatability be achieved?
A- Repeatability is a function of the backlash of the nut and therefore a preloaded nut can achieve zero lash. If you are referencing lead accuracy, then the price and time to achieve 1 µm / 300mm lead accuracy is not practical versus achieving a standard grinding tolerance of 8-12µm combined with positional feedback.

Q: Can you explain again, the concept of preloading?
A- Preloading of a nut is the act of removing the axial free play. This can be accomplished by selective ball bearing sizes (4-pt preload), multiple offset ball forms in a ball nut (skip lead preload), and by two opposing ball nuts (double nut preload).

Q: What is 4 point contact?
A- 4-pt contact is a method of preloading a ball screw. Through selective ball sizing, the axial free space is removed to eliminate the lash.
Q: What’s the best way to illustrate the difference between axial loads and radial loads in linear motion?
A- An axial load is applied along the length of the screw whereas a radial load is applied perpendicular to the screw.

Q: If I want retrofit an old machine and change the hydraulic pistons with ball screw, can you help me to select the correct ball screw?
A- Yes, please contact an application engineer to discuss the specifications.

Q: What’s the difference between lead and pitch?
A- Lead is the axial distance the nut travels in one revolution of the screw. The pitch is the axial distance between threads. The lead is equal to the pitch times the number of starts and the pitch is equal to the lead in a single start screw.

Q: Can the ball screw move heavy loads fast and accurately about 15 times per minute?
A- Yes, ball screws are rated for continuous operation.
Q: Are there any boots or other recommendations for protecting lead screws from debris or particles that may fall onto them?
A- Yes, protective devices exist to completely enclose a ball screw and prevent contamination. Thomson can supply an extruded aluminum enclosure for extreme environments and other suppliers can provide the accordion style boot. A seal or wiper is sufficient for most applications though.

Q: How do you brake lead screws in horizontal configurations?
A- It should be unnecessary to apply a primary braking system for a horizontal system in most applications. Power off brakes are available for most motors if necessary.

Q: When using a long lead screw component, how to solve the bending problem?
A- Intermediate supports can be successfully used for long screws. These are unique to the application and usually designed and installed by the OEM or customer. A typical support would look like a spring loaded arm with a plastic sleeve to hold the screw during operation that would drop away when approached by the nut.

Q: If the balls fall out of a ball nut, is there a procedure for repacking?
A- Yes, Thomson has a video in the ball screw section of the website that explains the process of loading the balls into a ball nut. If balls are lost or additional support is required, please send the ball nut back to Thomson for reassembly.

Q: Please explain efficiency in relationship to ball screws vs lead screws.
A- Expressed as a percentage, the ability of a screw assembly to convert torque to thrust with minimal mechanical loss. Lead screws operate by sliding friction whereas ball screws use rolling friction and therefore ball screws will have a higher efficiency. A small helix angle / small lead will also increase resistance and lower the efficiency.

Q: If ball screw load is one-fourth of rated Ca, does life increase by a multiplier of 4 to 4 million inches?
A- The L10 life equation for a ball screw is \((\text{Cam} / F)^3\). Since this is a cubic equation, if the load is \(1/4^{\text{th}}\) the dynamic capacity, the life will increase to 64 million inches.

Q: If we want move a thing forward and backward very quickly, which screw should we use, thanks!
A- This will depend on the load and duty cycle. Lead screws have a wider selection of available leads and therefore would be the ideal choice if the other parameters allow. Fast movement requires a high lead screw.