



Linear Motion. Optimized.

Q&A Session for Advanced Ball Screws 102: Troubleshooting for Design Engineers

Topic: Noise

Q: Is there a way to predict/calculate noise on a ball screw?

A: No, there is no way to calculate the noise of a ball screw. There are ways to minimize the noise of an application though. Larger ball screws utilize larger ball bearings and are therefore inherently noisier. External return systems are also inherently noisier than internal return system. The use of spacer balls can reduce the noise of a ball nut. The selection and proper application of grease can also reduce the overall noise level. Minimizing or eliminating back lash can also reduce noise in an assembly.

Q: Using a ball screw with a stepper motor driven system, can noise be reduced with a preloaded bearing?

A: Yes, a preloaded ball nut will be quieter than a ball nut with back lash. A preloaded ball nut adds complexity, cost, and increased torque into an assembly and therefore may not be a good solution if noise is the only consideration.

Topic: Lubrication

Q: What lubricating agent should be used?

A: The selection of the proper lubricant is dependent on the application, environment, and maintenance interval. Thomson offers a general purpose lubricant for ball screws in our TriGel 450R.

Q: How to define the right amount of lube to inject in a ball nut?

A: As a general rule, the ball screw should be "wet" at all times and a ball nut should be filled until grease escapes from the ends of the nut. High speed applications will require less grease (approximately 30% fill) or an oil lubricant.

Q: With oil, how do you determine required amount of lubrication for the ball nut?

A: A continuous drip should be used for oil lubrication.

Q: One question about lubrication - how do you clean these prior to re-lubrication if you suspect contamination of the existing lubricant?

A: A industrial degreaser and rag is sufficient to clean a ball screw. The ball nut must be removed, disassembled, and all components cleaned if it is suspected that debris or contaminants are present to prevent premature wear.

Q: Do you offer pre-lubrication on your ball screw products similar to your linear bearing line?

A: Ball screw components and assemblies are shipped with a rust preventative only unless otherwise specified by a customer. Custom lubricants are available upon request.

Q: What lubrication would be recommended in a waste water treatment plant?

A: The selection of the proper lubricant is dependent on the application, environment, and maintenance interval. It is impossible to select a lubricant based upon the industry without knowing the other specifications.

Q: Do you have a particular grease recommendation for a micro motion or "dithering" application?

A: A high viscosity and load bearing grease would be recommended. (i.e. Mobil Polyrex EP2 or equivalent)

Q: What do you recommend for seals or wipers to keep out contaminates? How is lubrication affected when using seals/wipers?

A: The precision inch series has optional nylon brush style wipers. The precision plus inch series uses formed nylon wipers. The FineLine metric series and precision plus metric series use formed Delrin wipers. The NEFF metric series uses formed rubber wipers. A brush style wiper is good for general purpose applications and will remove debris and offer some grease retention. A formed wiper will offer improved grease retention. A hard plastic wiper will be better at removing debris whereas a formed rubber wiper will be better to protect against loose contaminants.

Q: How do you keep oil lube contained? How do you feed it in?

A: Oil must be continuously drip feed into the ball nut or the ball nut may be submerged into an oil bath. Typical oil application require an oil pump, oil reservoir, and automation system.

Q: What are the best seals to be used in applications of high contamination?

A formed rubber wiper would be the best selection for this type of application.

Q: Can you recommend using dry lubricants in dirty/dusty environment?

A: The choice of lubricants is dependent on the application and environment. Contact the lubricant supplier for recommendations regarding selection of a lubricant for the specific application. Contamination of any kind will increase wear and reduce life regardless of lubricant used.

Q: Are there seals to retain the grease in the ball screw housing?

A: Wipers are available as standard or optional on most ball nuts.

Q: Are Sealeze brushes are adequate?

A: The precision inch series of ball nuts uses brush style wipers that are similar to the Sealeze brushes and therefore this type of wiper is adequate for certain applications.

Q: Do you have any experience with use of ball screw in an exposed marine environment?

A: Yes, we have over 60 years of ball screw application experience in all types of environments. Typically exposed marine environments would utilize a stainless steel ball screw or special coatings to protect against corrosion.

Q: Wiper will not retain grease I have had this happen already.

A: The grease retention capability of a wiper is dependent on the style of wiper. All wipers will allow some grease to escape and therefore it is necessary to perform periodic maintenance and lubrication.

Q: Can you present a PHOTO of these nylon wipers and brushes?



Q: Do you offer any materials that are corrosion resistant?

A: Yes, we stock many sizes in stainless steel and can custom fabricate many more. We also can offer corrosion resistant coatings when specified.

Q: Is there one lubrication for Wisconsin outdoors (hot and cold)?

A: This would be a better question for a lubrication provider. Standard industrial greases do not have the low end temperature rating that I believe you are looking for. Therefore, a grease with a lower temperature rating would be required.

Q: Besides wipers, do you offer any type of grease containment system, such as bellows?

A: No, we do not offer bellows but these types of products are commercially available.

Q: What other companies do you typically recommend for bellows or grease containment systems?

A: There are a number of commercially available bellow suppliers. We currently do not recommend or use one more than another. Please contact a bellow specialist for correct product recommendations and then determine the best product for your application.

**Q: Are waxy router bearing lubricants which do not attract dust effective on ball screws?
Specific types are Bostic Bearing Lubricant and Boeshield T9.**

A: Yes, these types of lubricants will be effective on ball screw assemblies although they may not provide the protection that more advanced lubricants can offer. It is always best to contact the lubrication supplier and obtain recommendations on the use of the specific lubricant.

Topic: Speed, Acceleration, & Loading

Q: When would a roller screw design be preferred?

A: Roller screws typically offer higher load capacities and increased stiffness when compared to an equally sized ball screw. This is only important when the space constraints prevent the use of a larger ball screw unit.

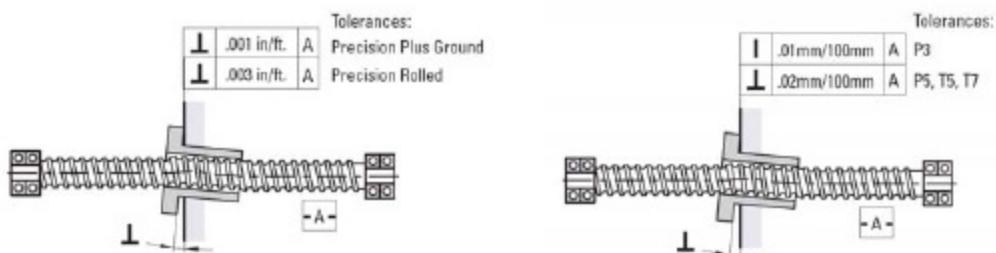
Q: What is your standard for preload stretch on the screw at installation?

A: It is not possible to actually stretch a ball screw upon installation. The type of end mounts will affect the critical speed and the column load capacity of the screw.

Q: How would you calculate the maximum acceleration a ball-screw can use with out getting ball skid?

A: A general rule of thumb is to calculate the ball nut critical speed based on $dN = 3000$ for inch series ball nuts and $dN = 140,000$ for metric series ball nuts. (d = nominal diameter of the screw and N = rpm). Contact Thomson if your application exceeds this rule of thumb or for options regarding high speed applications.

Q: What is the average amount of angular misalignment that ball screw assemblies can tolerate?



Q: Are there ways to improve the load capability of a ball screw?

A: There are no magic ways to increase the load capacity of a standard ball screw. A load carrying grease can help extend the life of an assembly but the overall load rating will not change. The load capacity of a ball screw is calculated based on the life of the ball bearing and the materials of construction. Better materials, larger components, larger ball bearings, and more circuits will increase the load capacity but require design changes.

Q: How do you know when you have optimum accelerations on an installation?

A: Acceleration consideration is most critical on vertically mounted applications where this component of load must be considered. The ideal acceleration rate will most likely be determined by the torque capacity of the motor and drive.

Q: When a ball screw is used in a column loading design, with a thrust bearing on one end and the ball nut loosely constrained, what end condition constant should be used for Euler Column calculations?

A: Fixed-Free = .25, Simple-Simple = 1.00, Fixed-Simple = 2.00, Fixed-Fixed = 4.00

Q: Setting proper backlash in a tolerance critical application?

A: Ball screw assemblies can be provided with standard back lash, minimal back lash, or preload. Preloading of a ball screw affects the repeatability of the positioning. Screw lead error will affect the accuracy of the positioning. If your application requires increased accuracy, then select a ball screw with reduced lead error.

Q: Is there a recommended ratio of the diameter of the screw to length of screw assembly?

A: Only in an application that has the ball screw in compression. Eulers Formula for column load strength must be used and is only valid if the slenderness ratio (L/d) is 18.25 or more. It is recommend that long slender screws be properly supported to minimize sag and vibration due to rotation.

Q: Does the ball screw nut assembly have the same capacity when comparing traditional mounting vs. rotating nut?

A: Yes, the load capacity is the same. The benefit of a nut driven system is the elimination of the critical speed calculation of the screw.

Q: What are the key design criteria to establish a servo drive driven ball screw assembly for stiffness? The ball screw drive has been the largest "spring element" when compared to our designs in machine tools.

A: In applications where stiffness is critical, a ground ball screw and a preloaded ball nut with integral flange would be recommended.

Q: Can you get a side load if set at an angle?

A: No, if the load is adequately supported and the ball screw assembly is isolated from the static load.

Q: What is the best solution for high temperature application (200C)? What is the maximum temperature you recommend for a general Ball-Screw assembly?

A: A general ball screw assembly will be temperature limited by the lubrication selected and the wipers if applicable. As the steel components are hardened, the temperature should not exceed the annealing properties of the steel which would decrease the tensile strength.

Topic: Wear

Q: How is backlash measured? What kind of instrument?

A: Back lash is the axial free movement between the nut and screw. The best way to measure would be to secure the screw from movement and axially push and pull on the ball nut while measuring the movement of the ball nut with a dial indicator. Overall system back lash can be measured by putting a dial indicator on the ball nut in the system and driving it 1" and back to the original position. The variation from zero is the overall system back lash.

Q: Is the shaft the part most likely to fail?

A: No, the life of the ball screw assembly is calculated based on the ball bearings.

Q: How wear can be predicted? Does it mean we can calculate how much we will get?

A: The wear and therefore life of a ball screw assembly is predictable based on the fatigue stress of the components. The dynamic capacity is determined based on the L10 bearing life of the ball bearings.

Q: What type of wear will we get if the application is small stroke (5mm) with regular load in a 5mm pitch ball-screw set.

A: For applications with small strokes, the life of the screw and nut must be considered. These calculations are special and cannot be calculated with the typical catalog life analysis. Contact a design engineer to review.

Q: Are the balls used in ball-screws the same alloy/hardness as those in standard rotary ball-bearings?

A: Yes.

Q: How does spinning the nut and keeping the screw fixed effect the wear of the assembly?

A: There is no difference in wear between a nut driven or a screw driven assembly.

Topic: Installation, Assembly, & Repair

Q: At the ends of the threads, where is shaft is turned for an end block what is the recommended radius at this location.

A: Standard journal undercuts are recommended. See a Machinery's Handbook or DIN standards for typical bearing journal undercuts.

Q: The question is not directly related to ball-screw-I am using a slide screw from Thomson- I drive it through a micron gear attached to a stepper motor. The gear is connected through a R+W bellows coupling. How to check whether coupling is slipping?

A: You would need to isolate the coupling and measure the slippage of the coupling only. You would need to mark the original position (scratch mark), operate the system, and then check against the final position.

Q: Are there some designs where the screw turns- and other designs where the assembly with the balls turn instead of the shaft?

A: Yes, a screw driven system is the most typical but nut driven systems are acceptable.

Q: Do you repair ballscrews (both Thomson product and others)?

A: Yes, we can repair or replace both Thomson and competitive ball screw assemblies. Rolled ball screws are typically not cost effective to repair. Ground ball screw assemblies can be reground and re-balled in some cases.

Q: Are torque limiters usually recommended for the prime mover?

A: No, torque limiters are not typically required for most applications.

Q: Is there any documentation on how to reassemble ball screw assemblies - specifically how to reintroduce the balls into the system?

A: No, there is no documented procedure to rebuild a ball nut. It is recommended that the ball nut be returned to the manufacturer for assembly. Although not complicated, if done incorrectly, a premature failure would occur. Therefore, this would void any warranty.

Q: Do you get position feedback?

A: Positional feedback can be obtained on the drive system or via a linear optical scale (or equivalent).

Q: For a given screw thread can a ball screw be fit into the same place such as in milling machines?

A: Yes, we can recommend replacement assemblies. Variations in the overall dimensions and the interface dimensions between manufacturers makes a direct drop-in replacement difficult. One manufacturer's ball nut will typically not work on another manufacturers screw though.