Q&A Session for Advanced Linear Bearings and Guides 201 : Troubleshooting for Design Engineers

Date: April 22, 2009

Q: We are currently looking into using Self Lubricating Bushings in a high-load Off-Highway application, do you have any recommendations for material, or perhaps even a product?

A: We recommend the Thomson L4L accessory. It has a proprietary material that serves as an oil reservoir and outboard seals to protect the bearing from contaminants. The solid lubricant provides continuous lubrication for the life of the bearing. As an added benefit, the L4L accessory also acts as a great seal for the bearing, which can be important for contaminated environments such as MOH applications. The L4L option is available on standard Thomson Super and Super Smart Ball Bushing bearing pillow blocks, or as retrofit kit for custom housings.

Q: What is the definition of high speed?

A: High speed applications are speeds from about half way to the maximum speed limit of the linear bearing. This is 3 m/s for most Thomson Ball Bushing bearing products, 5 m/s for most ball profile rail, and 3 m/s for most roller profile rail.

Q: How do you keep contaminants off the rails as in a plasma cutting table?

A: Bellows should be used to protect rails from contamination. For a plasma cutting table application, we would recommend our profile rail “Walk-on” bellows, which are best suited for harsh environments like welding and grinding. Additionally the bearing block or carriage itself may benefit by having a lube block or “Lube for Life”.

Q: What is the number one cause of bearing failure other than misalignment?

A: Lack of lubrication is one of the leading causes of bearing failure. Some customers assume the rust preventative oil that the bearings are shipped in is adequate, or only lubricate the bearing once during installation. The bearings’ catalog dynamic load capacities assume proper lubrication, which typically requires appropriate lubrication intervals.

Q: Do you have Stainless Rail?

A: Thomson 60Case Round Rail shafting is available in both 440C and 316 Stainless steel in many sizes. Thomson ball type profile rails are available in 440B stainless steel in sizes 15 and 20 mm.

Q: What impact does carriage speed have on bearing life?

A: For our rolling element bearings, as long as the bearing speed is kept within the maximum speed limit of the bearing, the speed will not affect the life of the bearing, unlike plain contact and air bearings. Speeds in excess of the maximum stated speed can lead to rolling element skidding, and premature failure. In addition to speed, bearing acceleration/deceleration must be within catalog limits. Also, beware that the speeds and accelerations are not causing additional loading above beyond the steady state loads.

Q: We are currently manufacturing an aluminum block and inserting 4 Super Smart bearings and 8 seals. How important is the fit of the bearing to the housing?

A: The fit-up of the Super Smart Ball Bushing bearing in its housing is very important, as it will ultimately determine the fit-up between the bearing and the 60Case shafting. Recommended housing sizes are specified in the Thomson RoundRail Linear Guides and Components catalog, as well as the bearing-to-shaft fit-up. If the recommended housing size provides too much clearance between the bearing and shafting, a slightly undersized housing can be utilized to tighten the bearing to a line-to-line fit, or light preload if desired. Be careful that the machining and tolerances of the housing is appropriate as over-preloading may result in shorter than anticipated travel life.

Q: Are there tools to assure parallelism during installation (say between two rails of linear bearings in a moving carriage type of set up)?

A: The simplest tool one can use to insure parallelism between two or more rails is a set of gage blocks. Starting in the middle and working towards the rail ends (as described in the presentation), one should bolt down the second rail with respect to the first while moving the gage blocks.

Q: What is typical load rating difference in roller type round rail and FlouroNyliner type?

A: Not only are the running characteristics different, Ball Bushing bearings have a different failure mode than plain contact FluoroNyliner bearings and therefore have very different types of load ratings. Sliding contact bearings like the FluoroNyliner are rated based on PV (pressure x velocity) limits of the material. Rolling contact is rated based on material Hertzian stress limits. However when comparing static load capacity, using the Super Smart Ball Bushing bearing for example, a FluoroNyliner bearing will typically have 1.5 – 3X higher static load capacity.

Q: I currently use the super smart ball bushing pillow blocks on 60 case linear rail. How will the adjustment screws affect performance or premature failure?

A: The adjustment screws in our adjustable Super Smart pillow blocks are set in the factory to the recommended housing bore size. As mentioned in the presentation, these screws can be tightened to put the bearing in a line-to-line fit, or a light preload. However, a heavy preload is not recommended, as it can detrimentally affect the smoothness of the bearing, and lead to

premature failure. To set a consistent preload, we recommend using a slightly undersized "dummy" shaft when tightening the adjustment screws.

Q: What is pre load?

A: Bearing preload is an interference fit between the outer race, rolling elements, and inner race of the bearing. The purpose of preloading a bearing is to remove any internal clearance in the bearing, to limit deflection. As heavier preloads (i.e. greater interference fits) are applied to the bearing, bearing deflection can be limited even more. Preload in a round rail bearing is typically achieved by adjusting or using an undersized housing bore and/or oversized 60case shaft. Preload in a profile rail is set in the factory by using oversized rolling elements.

Q: What about the set screws for preload? also adding grease zerks?

A: See the above question about setting adjustable pillow blocks. All round rail pillow blocks come with a tapped hole in the side of the block for the addition of a lubrication fitting. The fitting can be added by the customer, or a special pillow block can be supplied with the customer's specified lube fitting.

Q: What's wrong with running re-circulating ball type dry if loads are not high?

A: Although there are some applications that have "worked" run dry, for standard rolling element bearings, even under light loads, lubrication is required. A boundary layer is required to act as a barrier between the steel bearing elements to prevent the materials from bonding together. This layer is ideally a lubricant film to provide beneficial tribological characteristics. The ElastoHydrodynamic Layer is in between the rolling element and the race, supports the load as well as prevents the material from bonding. Load, speed, environment, material, etc. are important parameters to consider to specify the correct lubrication conditions. Even a dry lube is preferred over no lube. Aside from the benefits to load, a lubricant will help product the steel from corrosion.

Q: What is the maximum diameter available for the Super Series? I need a 2.5" size.

A: The maximum size Thomson Super Ball Bushing bearing is 2". If a larger size is need, one could use either the Thomson XR Ball Bushing bearing, or a RoundWay roller bearing, both which have a 3" diameter size available. However, while the XR bearing does have ball conforming bearing plates like the Super bearing, they are not self-aligning.

Q: You showed an accuracy of .0001" over a 120" rail length--that is an angular wander of <1 microradian. Is that realistic, and if so, what could be accomplished over a travel of only 10 mm? The load I have in mind is less than 0.1 lb.

A: The table actually showed an accuracy of +/- .0001", or .0002" (5 μm). The plot of the actual bearing accuracy versus rail length can be seen in the plot on page 40 of the Profile Rail Linear Guides catalog. While these are accurate number, remember this does not take into account inaccuracies in the rail mounting surface.

Q: Are QPQ treatments ever applied to the shaft in order to minimize friction and increase life?

A: The proprietary process we use to produce our 60 Case shafting yields an optimal surface finish often better than 8Ra. Based on comparative testing our shafting is one of the highest performing standard shafts on the market. Special treatments like QPQ, as well as coatings and platings can be applied to the shaft for special requirements, however the degree of benefit starts becoming somewhat application specific. There are so many other parameters, like the type of bearing being used with the shaft, the environmental conditions, the type of lubricant used, etc. that may have an even higher impact on the final friction and life results.

Q: Oil vs grease on rails with dry alum chips hitting them?

A: If the application conditions can go with either oil or grease, then for standard machining conditions oil will have less tendency for the aluminum chips to stick to the rails than grease, due to the difference in surface tension as result of the lower viscosity of the oil. If it is possible, scrapers, seals, and perhaps a Lube for Life option could be used for additional protection, and for additional protection from contaminants, bellows would shield the rails from the chips, allowing the option of grease to be used with less risk of the chips adhering to the rail.

Q: got anything that can run on a cable and transition to a track?

A: This is very size dependent. For relatively large sizes, a RoundWay would be an option. For intermediate sizes, cam-follower bearings can likely be configured to work. For smaller sizes, there can be specialty bearings that can be configured using a segmented technology that could handle this if the volumes justify.

Q: Could you make a super type cartridge to allow us to "assemble" a bearing loop larger than 2"?

A: Yes, cartridge or segmented bearing technology affords us a great deal of flexibility in providing creative special bearing designs. There is still some minimum volume requirements, but the capability enables us to provide tailored solutions efficiently.

Q: What is the difference between a spall and a groove?

A: Material fracture, edged breaks and debris versus plastic deformation and material flow.

Q: How long before the lube for life needs to be replaced?

A: 30,000 km.

Q: What type of oil is in the Lube for Life polymer?

A: A Polyolefin or equivalent oil which is compatible with most mineral based and synthetic oils

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Q: How effective is grease for noise attenuation?

A: Depending on the type of grease, it can be a very effective damping media, reducing the dB level significantly, however, the grease channels, and then depletes itself from noise absorption over time, and will need to be re-charged / re-applied.

Q: Are ball chains better than ball spacers for noise and vibration reduction?

A: No. The chain has a large gap at the end of the chain, and can therefore result in a noticeable "bump" should the gap synchronize; which it will invariably do; further there is a potential for the chain to break, which would increase the risk of this event.

Q: Isn't Nickel Plating better than Chrome for corrosion protection?

A: Yes, for a non-contact scenario, BUT for bearing applications, the nickel is much softer than the chrome and cannot stand up to the hertzian contact stresses as well.

Q: Can Stainless Steel be plated to increase corrosion protection?

A: Depending on the exact application, materials, and plating, there may be a net benefit, but it is possible that the stainless steel itself may have reduced hardness due to the change in surface chemistry. This may lead to a higher potential for the plating to crack and come off.