



Issue 28: Required Minimum Load

Required Minimum Load

I originally discussed this topic back in 2012. Since this issue continues to rear its ugly head, I felt it was time to re-boot this article.

Bearings fail in so many unique ways and digging deep and finding the true root cause is extremely difficult. Once you find the root causes, the next hurdle is agreeing with the root cause and take steps to resolve the issue. One of the most overlooked and hard to prove root causes is any failure resulting from not meeting the minimum loading requirements.

What is Minimum Loading?

It is the amount of load required to generate enough traction between the raceway and the rolling element surfaces to achieve proper rolling as the rolling elements pass in and out of the load zone.

What Bearings Require a Minimum Load?

It is commonly mistaken that minimum loads are only required on roller bearings. Deep groove ball bearings (DGBB) require an amount of minimal loading also to achieve the best service life. In most cases with a DGBB the loading required is very low. The weight of components or a magnetic pull is enough loading to meet the requirements.

Two scenarios come to mind with a DGBB where the minimum loading might not be achieved by the weight of components or magnetic pull. An application where a bearing is selected based on size, OD, ID, W, instead of loads and speeds. In this scenario the loading might not be enough to avoid smearing, skidding or even cage damage. Another application would be where rapid accelerations or starts and stops are present.

I am not a big fan of generalizing but the “rule of thumb” for a DGBB is:

0.01 X Basic Dynamic Load Rating

Equation 1

Roller bearings also have a basic “rule of thumb:”

0.02 X Basic Dynamic Load Rating

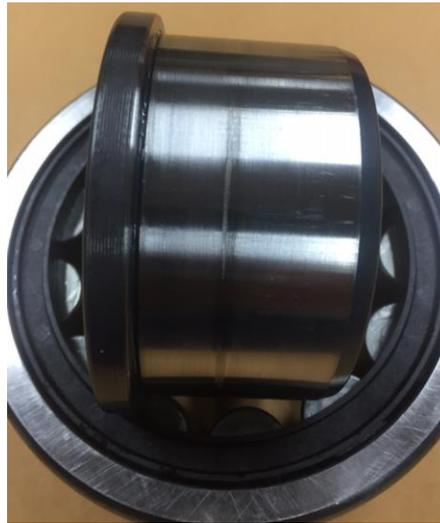
Equation 2

I recommend reviewing the more complex formulas that can be found in most bearing manufactures catalogs.

The minimum loading requirement can be overlooked in most bearings that require preload such as tapered roller bearings (TRB) and angular contact ball bearing (ACBB). The preloads that are applied normally exceed the minimum loading requirements.

Complex Problem

Minimum loading is difficult to conclude as a root cause because in many cases it results in damage that is not witnessed until a later date. Motors and pumps are often operated without load. If a cylindrical roller bearing is being used it could cause the scenario where the rollers will slide rather than roll over the lubricant. At times this issue is heard as noise, often described as the “bearing screaming.” This condition can result in multiple issues that may not be discovered until a later date. This condition can cause unexpected shear forces in the lubrication, causing heat, resulting in shortened grease life. Another possibility is that this sliding could cause skid marks, galling, frosting, or other metal surface damage that could progress into premature fatigue failure.



Pic 2: CRB with Skidding after bench test.

How Do I Identify This Failure?

Once a bearing has a catastrophic failure, the damage caused by operation without the required minimum load is often masked by other damage. Concluding that this type of damage has occurred is normally found by interviewing the operators and mechanics. I believe the key is acknowledging it exists and take the action required to stop it. A simple test to show how it works: take a CRB, TRB or spherical roller bearing (SRB) and lightly rotate a ring or cup and watch the roller action. Now repeat this action applying a small amount of load with your hands, notice how the rollers now properly rotate.



Pic 2: Loading Device

Conclusion: Build That Loading Device!

The minimum loading requirements are not extremely high, but can cause your bearings to fail prematurely. Identification is difficult, so the best solution is to try to avoid them at all cost. I have always challenged companies to build their own concept of a shaft loading device, but if you don't have time for that creative element the EASA website has a version or contact Midpoint Bearing for assistance. If you would like to review the required minimum loads please visit the technical section of our website: <https://www.midpointbearing.com/technical-info/>

If you have any questions, comments, ideas for future topics please feel free to contact me directly at bud@midpointbearing.com

