



Isn't it all really just the same?

An Open Comparison of Hardened Steel Linear Shafting

Introduction

Every linear bearing application requires a linear shaft as the inner raceway. However, many times that inner race is overlooked in the design process because it is presumed to be part of the bearing solution. Other times it is merely considered insignificant. It is also the case that in the procurement stages, linear shafting is quite often thought to be a commodity; in other words, it's all the same.

The truth is that all three of these scenarios can lead to premature system failure and high costs for maintenance time and replacements. The truth is that the shafting utilized in a linear application is just as critical as the bearing chosen.

For the design engineer, it must be compatible with the bearing, it must be made of high quality material processed to exacting tolerances, and it must provide the optimum in performance. For the procurement agent, just by the very fact that it is a bearing system, it is expected to be all of the above as well as be readily available at the best cost-to-value ratio possible. But the reality is that not all linear shafting meets the same quality standard and the differences are not always readily apparent.

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To prove that all linear shafting is not the same, PBC Linear engaged the Ferdinand von Steinbeis Technical Institute of Stuttgart, Germany to conduct an independent study of leading suppliers of linear shafting. A synopsis of their results comparing the hardened steel **RC60 Linear Shafting™** from PBC Linear with an industrial leading brand of linear shafting follows.

Dimensional Data

Consistent dimensional tolerances along the entire length of a shaft are critical for consistent bearing operation. Any variances will be transferred through the bearing producing inconsistent results in the entire assembly.

RC60 Linear Shafting is produced through a process that has been developed and refined to deliver the highest levels of repeatability in dimensional tolerances.

The result is a shaft that supplies greater uniformity of load distribution through the bearing, improved system accuracy, and increased bearing life. These results are seen in all types of bearings including both rolling element and plane bearings. Rolling element bearings have an increased life expectancy due to a greater normalization of load distribution. Plane bearings have a lower coefficient of friction and decreased binding occurrences due to a more consistent contact interface with the shaft.

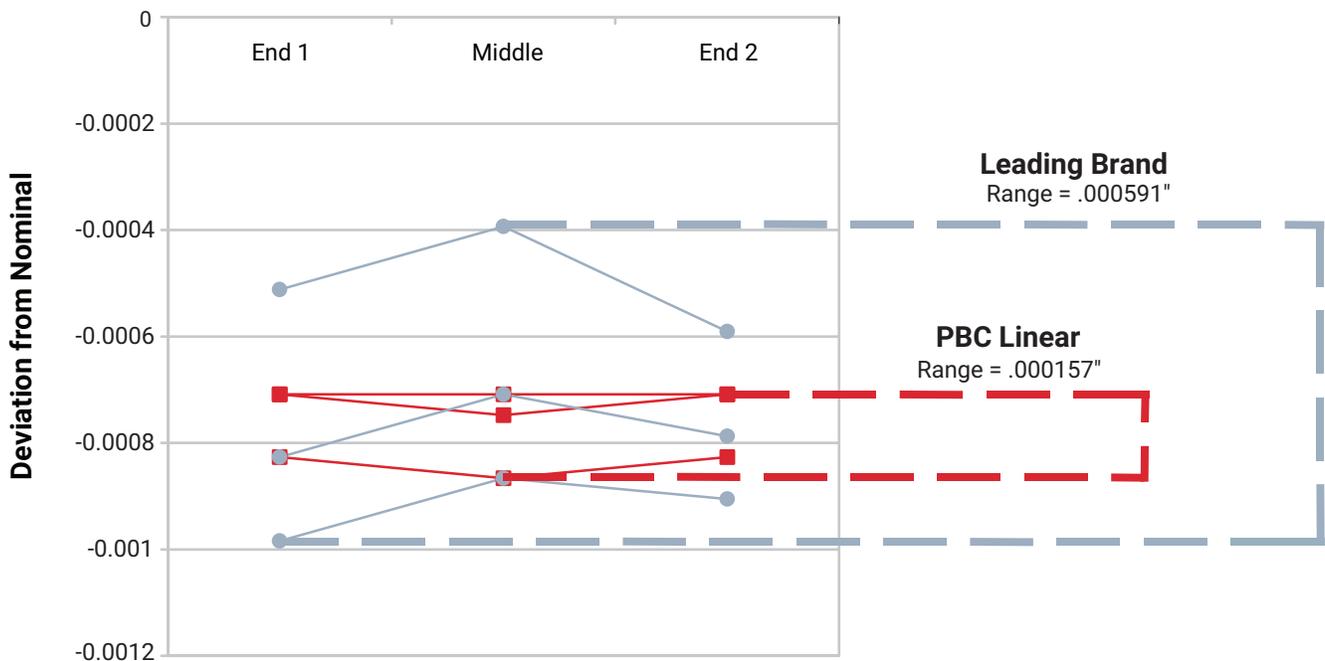
Roundness at one given location is important, but maintaining it at any given cross section along the shaft is most important. Not only does it result in true roundness, but also it builds into the process high levels of accuracy for cylindricity and straightness.

The chart below contains actual inspection data from three different diameter shafts each being inspected at the ends and in the middle. The results show that the **RC60 Linear Shafting** from PBC Linear holds a range that is 73% better than the leading brand.

Any variances will be transferred through the bearing producing inconsistent results in the entire assembly.

▼ Dimensional Data Chart

- PBC Linear 1
- Leading Brand 1
- PBC Linear 2
- Leading Brand 2
- PBC Linear 3
- Leading Brand 3



Surface Finish Data

Surface finish is a key factor in bearing performance, affecting areas such as cleanliness, load, life, and coefficient of friction.

ALL **RC60 Linear Shafting** is ground and polished within a consistent surface finish range resulting in a higher level of predictable performance. This consistency is built into a refined process that is tightly controlled in all aspects.

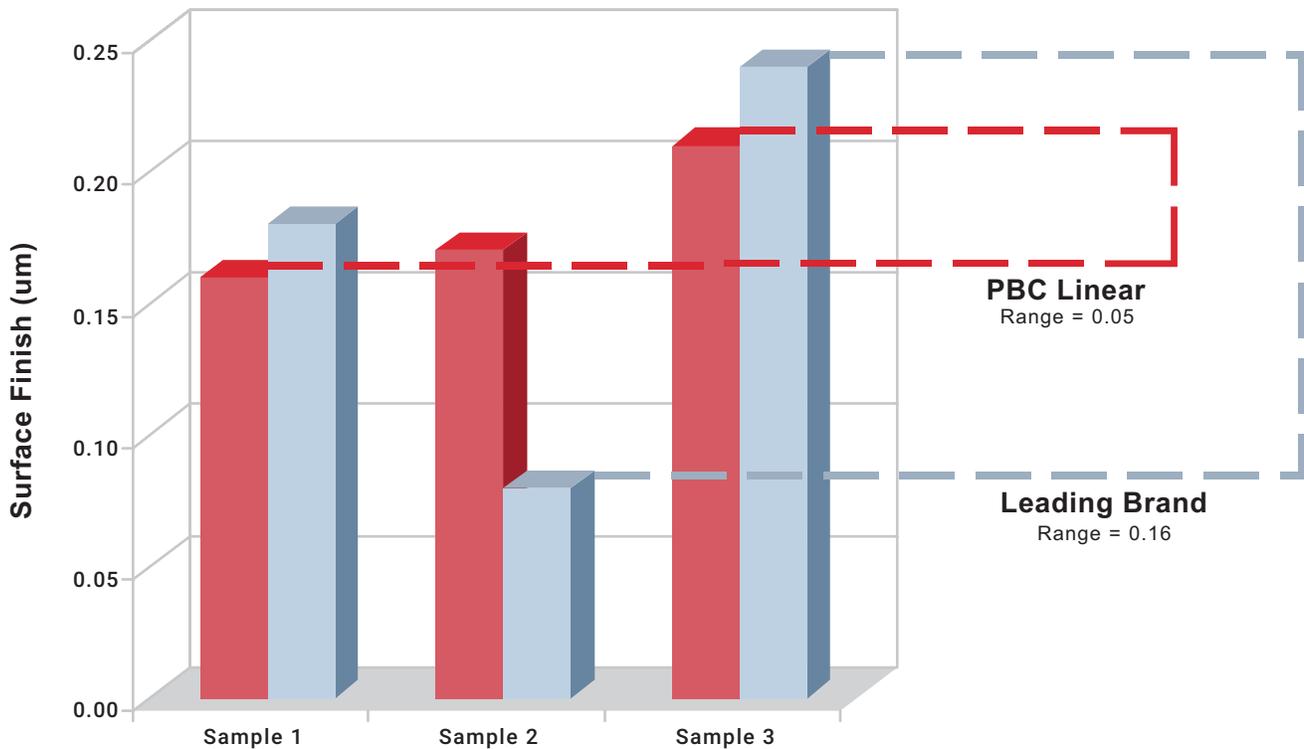
These resulting benefits are produced:

- Loading is more evenly distributed as the balls or bearing surface have an increased contact area with the shaft.
- The polished finish equates to a decreased amount of wear particulate being generated by the bearing-shaft interface in operation. This minimized particulate generation increases the range of applications (especially in clean rooms) where it can be used.
- The polishing process also removes microscopic peaks from the shaft surface resulting in a consistently smooth surface reducing drag (friction) on the bearing components.

The **RC60 Linear Shafting** from PBC Linear repeatedly tested in an average range 50% greater than the competition for surface finish consistency.

▼ Surface Finish Data Chart

- PBC Linear
- Leading Brand



Hardness Data

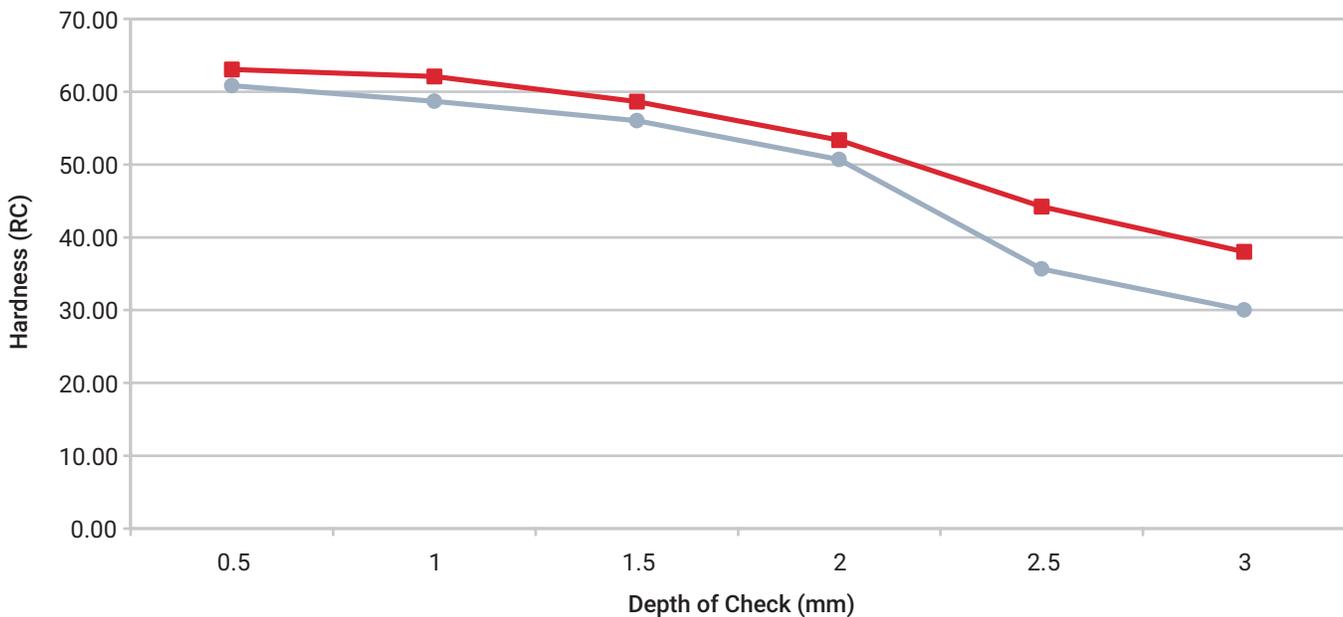
Steel linear shafting is surface hardened to increase its resistance to deflection and damage due to point loading or line contact of rolling element bearings. It is also needed to increase the wear capabilities of the material thus extending the life of any bearing-shaft assembly by holding acceptable operational tolerances for a longer period of time. Two factors come into play when analyzing hardness: the hardness measurement itself and the depth of hardness.

As the surface of the shafting becomes harder, performance in all areas is increased. But to maximize the effects of hardness, it needs to be held evenly as it penetrates into the material. Sudden drop offs in hardness at shallow depths can cause the surface to become brittle and result in premature wear. Drop offs in hardness deeper into the material minimize the hardening effect with the shaft often not performing up to specifications.

The chart below shows the averages of three different diameters from each supplier that were tested by the Ferdinand von Steinbeis Technical Institute. The results show that the **RC60 Linear Shafting** from PBC Linear provides the most consistent surface hardness and depth of hardness across a range of sizes.

▼ Hardness Data Chart

—■— PBC Linear
—●— Leading Brand



Summary

Packaging equipment, assembly lines, pick-n-place robotics, automotive plants, steel mills, paper processing, media retrieval, printers, plotters, machine tools, door guides . . . **ANY** application that requires linear movement requires linear shafting. While many consider it a commodity or “just a part of the package”, it is in reality as critical a component as bearing itself. The shafting provides the inner raceway from which the bearing transfers any variation. What complicates making the evaluation and best choice is the fact that not all hardened steel shafting is created equal.

This closer inspection of the leading linear shafting available has revealed three critical areas that differentiate the best option.

- Dimensional tolerances
- Surface finish
- Hardness and depth of hardness

This independent study has revealed that the refined manufacturing and finishing processes designed to hold a tighter range of variance in all three of these areas in an ongoing consistent manner has resulted in the **RC60 Linear Shafting** from PBC Linear being the optimal choice for **ANY** linear bearing application.

Further Information

If you're still having difficulties, contact a PBC Linear Application Engineer to discuss your application. You can contact an engineer directly by calling 1.800.962.8979 (from within the USA) or +1.815.389.5600 (from outside the USA). If you prefer, e-mail an engineer at: appeng@pbclinear.com

Version

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