



NTN CORPORATION, PASSION FOR INNOVATION

The NTN Corporation is an important partner for companies that are present in the machine tool market. Due to long-term and close business relationships with leading companies in this market, in the course of the 100-year history of NTN, forward-looking innovations have emerged based on customer and market needs. The result is a comprehensive portfolio consisting of high-precision bearings, linear guides and ball screws. To clarify in figures, it should not be left unmentioned that around 5,000 machine tools equipped with bearings from NTN Corporation are exported from Japan to Europe every year. Of course, the machine tool market continues to develop. Thanks to the R&D departments NTN offers suitable solutions for current trends such as Industry 4.0 and an increasing automation.

In the service of the machine tool

Machine tools produce components for other machines and are therefore also referred to as "mother of machines". The economic production and the quality of the products produced depend on the technical level of each machine tool. The machine tool must therefore be assigned a key position in every industrial company. Conversely, the failure of a single machine tool component leads to bigger problems, because either the order is not completed on time or the required quality is not achieved. Therefore, every single component must be considered with the greatest care in the design phase, as tests are time-consuming and costly, and repetition of these tests should be avoided. The selection of suitable products is therefore a fundamental point to keep the development costs within limits or later to guarantee the economic targets of the end customers within the entire lifetime of a machine tool.

In this perspective of perfection, the NTN Corporation has established itself as a trustworthy partner of world-famous manufacturers of cutting machine tools for more than 100 years. As already mentioned, around 5,000 machine tools equipped with bearings from NTN Corporation are exported from Japan to Europe every year. Companies that use Japanese machine tools in their production appreciate, among other things, their high accuracy and reliability.

To achieve these properties and to guarantee them in the future, a team of experienced specialists is available to machine tool customers in Japan, anytime.

"In Europe, NTN-SNR, the European subsidiary of NTN Corporation, offers its customers the same service. Experienced application engineers, test benches, laboratories in Germany and France as well as a production in Germany serve the high demands of our customers," explains Martin Karius, Market Segment Manager at NTN-SNR.

Already in the design phase, designers can have access on a large pool of bearings for their individual design idea. The application engineers from NTN-SNR are ready to support them. For example, the pool of high-precision angular contact ball bearings includes:

- 4 series (78, 79, 70 and 72)
- Different contact angles (15 °, 20 °, 25 °, 30 ° and 40 °)
- Standard, high speed and super high-speed versions
- Open and sealed design

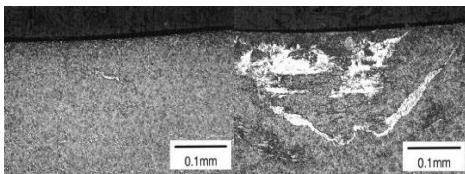
In addition to the customary P42 tolerances (dimensional accuracy according to P4, running accuracy according to P2), there is also the option of selecting application-specific accuracies to achieve the desired quality of the products to be processed. In addition to the adaptation of tolerances, there are

several options at NTN-SNR to optimize the accordant customer-specific product regarding the requirements for economy, accuracy, and reliability. It goes without saying that our laboratories in Germany and France also support our customers with detailed analyses to guarantee the successful start of the series and to determine the cause of failed bearings in the field.

Steel quality: a key parameter for highly precise bearings

In addition to collision damage, wear and inadequate lubrication are the main reasons for premature bearing failure in a machine tool. NTN is aware of this failure mechanism and has been offering its customers the LA material for high-speed applications since 2000. The LA material is a through-hardening bearing steel with an increased content of silicon, nickel, and carbon.

The increased content of silicon means that the steel is more resistant to tempering. The higher carbon content resulting to an increased size and number of carbides helps to resist deformation. Therefore, the LA material also has a consistently high hardness and is also dimensionally stable up to temperatures of 250 ° C, which is a basic requirement for use within the machine tool. Nickel delays deformation and cracking, which has increased the rolling contact fatigue life. In the two following images you can see the micrographs of bearings made of 100Cr6 (SUJ2 in Japan) and the LA material (left picture) that have already been used in rolling contact fatigue. Although the LA material has endured more load cycles, it still shows no signs of damage.



Due to the chemical composition and an improved surface quality, our customers can expect the following advantages from the LA material compared to 100Cr6:

- 6 times higher wear resistance
- 15 times higher anti-seizure properties
- 13 times longer rolling fatigue life at room temperature and a 30 times higher rolling fatigue life at 200 ° C

Customers all over the world have trusted these properties since 2000. To be more precise, it should not go unmentioned that around 2.000 machine tools which are exported from Japan to Europe every year, the spindle bearings of them are made of LA material. Due to the increased performance that results from using the LA material, the maintenance costs for the main spindle can be reduced, significantly.

Innovations that answer to the trends in the markets

Sensor Integrated Bearing Unit

The consideration of the total cost of ownership (TCO) within a company is of crucial relevance.

A point not to be neglected is the cost of maintenance. The main approaches to machine maintenance so far have been either preventative or corrective. With these maintenance approaches, there is a correspondingly large potential for savings, as either functioning components are replaced as a precaution or parts are replaced after damage. Predictive maintenance is used to reduce maintenance costs. For this, it is necessary to collect and analyze large amounts of data to predict the time of the failure as precisely as possible to be able to plan maintenance in a more targeted manner.

To be able to determine the current condition of spindle bearings, the R&D departments of NTN have developed a bearing unit with integrated sensors. The bearing unit, which was first presented in 2018, consists of two high-speed bearings from the HSE series. Between these two HSE bearings there are two spacers. Inside the outer ring spacer several sensors are placed in. These measure vibrations, the heat flow, and the temperature development within the bearing unit. Thanks to the measurement next to the bearings the gained data are more precise compared with the usual measurements on the spindle housing.

In the next development step, highly sensitive load detection sensor were built into this unit. This means that the loads acting on the bearings can now be determined during operation and the preload in the bearings can be set more quickly and more precisely during assembly. In addition, the data obtained are transmitted wirelessly. For this purpose, a built-in generator generates the necessary electricity during the rotation of the spindle, so that a radio module, which is also integrated, can transmit the determined data.

Machine Tool Spindle Bearing with Air Cooling Spacer

With the air-cooling spacer technology, NTN has also developed a solution that makes it possible to further increase the limits of the standard preloaded bearings or even to challenge the usual spring preload.

The system consists of at least of two or four high-speed bearings from the HSE series or the sealed BNS series, which are installed with a certain preload to form an O-Arrangement or Tandem-O-Tandem Arrangement. In doing so, normal compressed air flows onto the inner spacer, which is located between the bearings, whereby the temperature delta between the inner ring and the outer ring is reduced. Depending on the respective volume flow, the temperature difference in the case of HSE bearings can be reduced by more than 10 degrees. The advantage for the designers of spindles is that the originally selected preload and the speed can be increased.

This development enables speed parameters of up to 2.1 million to be achieved, with a simultaneous increase in preload (more than 1,000 N for a 7014 bearing). It should not go unmentioned that this development has been successfully tested in motor-driven and belt-driven spindles.

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