

NSK

NSK NH/NS Linear Guide Technology: Design Flexibility and Maximum Load Rating for High-speed Applications

While ongoing advances in linear motion technology continue to increase speed, efficiency and production uptime, the introduction of NSK's NH/NS technology has proven to achieve not only 10 times longer linear guide service life but a 20% increase in production speed. The choice of composition material and lubrication can have a significant impact on linear guide reliability, particularly in clean environments which necessitate frequent washdowns. The introduction of NH/NS Linear Guides in stainless steel material combined with K1™ Lubrication Units has proven to reduce replacement intervals in practical application by as much as 90% (see Case Study).

This whitepaper gives an overall explanation of NSK's NH/NS technology and details its critical elements in improving performance in high speed, high precision applications.

The Design Challenge

Designing machines that achieve sufficient speed and precision while minimizing cost is a continual challenge to the creativity and ingenuity of the precision design engineer. NSK's NH/NS linear guide technology offers greater flexibility by enabling the design of machines with greater load capacity within a smaller footprint, while improving speed, reliability and overall performance.

Solution Overview

NSK's NH/NS technology has achieved a significant increase in reliability and service life in high-precision linear motion applications. The new design includes new ball groove geometry which optimizes the distribution of contact surface pressure, and increases load rating capacity. Service life is further extended through the application of a continuous lubrication system (NSK K1™).

- **Durability**

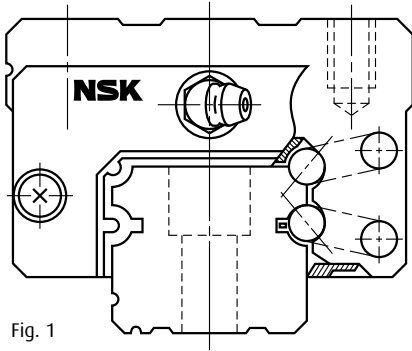
NH/NS Linear Guides have demonstrated twice the service life of conventional products, with a load rating 1.3 times greater than conventional linear guides. The increase in load rating enables machine design to be downsized and increases design flexibility.

- **Maintenance**

The addition of an NSK K1™ lubrication unit enables long-term, maintenance-free operation that reduces both cost and environmental impact. The K1™ lubrication unit is a device which combines oil and resin in a single unit. The porous resin contains a large amount of lubrication oil. Touching its surface to the raceway of a rail close to the ball contact point constantly supplies fresh oil and ensures optimum lubrication for continuous, smooth and efficient operation.

• Self-alignment Capability

Similar to the DF combination in angular contact bearings, NH/NS self-aligning capability is high because the cross point of the contact lines of balls and grooves comes inside, reducing moment rigidity (Fig. 1). This increases the capacity to absorb errors in installation for ease in achieving precision in mounting the linear guide.



Note that rigidity defines resistance to external forces within a range of elastic deformation to deformation. In the context of linear motion devices, moment rigidity is the ability of a linear guide to support off-center loads. Moment rigidity depends on the guide series, size, preload and (as mentioned) ball groove arrangement geometry. Linear guide manufacturers list moment-rigidity values in catalogs.

Also note that DF angular contact bearings are those with a face-to-face arrangement and relatively little distance between the effective load centers. So, these bearings have less capacity to sustain moment loads than others, but accommodate housings that have less accuracy or larger shaft deflections due to low bending stiffness of shaft.

For more information, download E1254f pages 148-151.

• Ball Groove Geometry

While retaining the use of a unique offset gothic arch groove, as shown in Figure 2, the new ball groove geometry in the NH/NS product has been developed using state-of-the-art tribological and analytical technologies. The new design optimizes the distribution of the contact surface pressure, which results in a dramatic increase of rating life.

For example, Figure 3 demonstrates when a super high load (impact) is applied, the offset gothic arch groove spreads the load to surfaces, which usually do not come into contact in the ball type NSK linear guides. This dramatically increases the impact load resistance. When compared to NSK's previous

LH/LS Series, comparable to most conventional linear guides, the load rating capacity of the new NH/NS Series has increased 1.3 times and the life span has increased two times*.

* Representative values of each series.

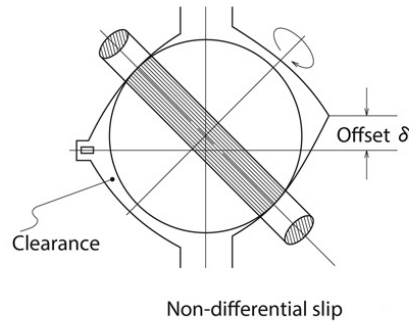


Fig. 2

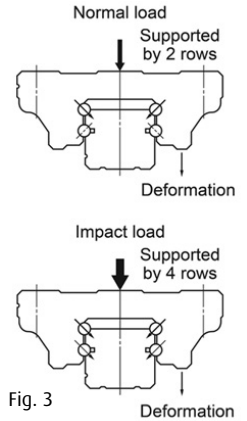
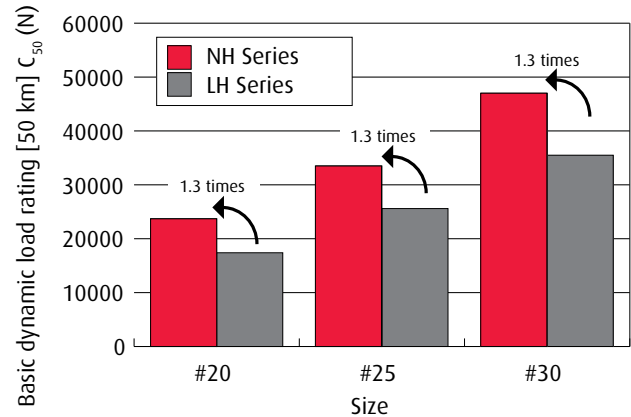
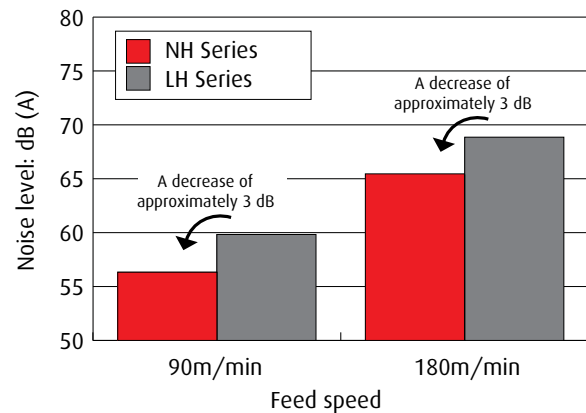


Fig. 3



By re-examining the design for the ball circulation path, smoother ball circulation has been achieved, and noise level has also been reduced.



*Measurement results are obtained from the size #25 linear guide alone. Microphone position: 500 mm above the top of the specimen. The noise level varies depending on the microphone position.

Case Study

A bakery that was using conventional linear guides was experiencing failures every three weeks on their band cutter machines. NSK Field Engineers examined the linear guides, which, though they were Armoloy™ coated and used food-grade grease, were not delivering the required standard of performance.

To address the excessive maintenance, downtime and lost production caused by the ongoing failures, NSK NH/NS High Speed Series stainless steel linear guides with food grade grease and FDA-compliant K1™ Lubrication Units were installed. In the facility's standard operating conditions, the NH/NS Stainless Steel Linear Guides performed 10 times longer and at a 20% faster production speed than the conventional linear guides. They also increased efficiency by improving operating speed from 250 cycles per minute to 310 cycles per minute. Further, the linear guide replacement interval was reduced from three weeks to 32 weeks.

All five of the bakery's band cutter machines were interchanged with NSK NH/NS Linear Guides. The significant reduction in downtime and replacement costs that was achieved resulted in an annual cost savings to the facility of \$229,120.

Cost Saving Breakdown

Issue

› Replacement Cost: Cost of bearing x 5 machines @ 3 week replacement intervals	\$86,665
› Downtime: 4 hours @ \$500 = \$2,000 x 3 week replacement intervals on 5 machines	\$173,330
Total	\$259,995

Solution

› Replacement Cost Reduced: Cost of bearing x 5 machines @ 32 week (8 month) replacement intervals	\$14,625
› Downtime Reduced: 4 hours @ \$500 = \$2,000 x 32 week (8 month) replacement intervals on 5 machines	\$16,250
› Production: Production speed was increased by approximately 20%	
Total	\$30,875

Total Cost Saving \$229,120

Specifying NH/NS Linear Guides

NSK's NH/NS Linear Guides are used for a wide variety of applications in factory automation, machine tool, transfer/gantry systems, packaging equipment, medical technology, semiconductor and woodworking machinery.

For additional technical information, publications featuring NH/NS Linear Guides or assistance with machinery/equipment design requiring linear motion solutions contact NSK Americas at **1.888.446.5675** or visit us at **www.nskautomation.com**.