

NSK K1™ Lubrication Unit: Extend Life in Harsh Operating Conditions with Maintenance-Free Operation

While ongoing advances in linear motion technology continue to increase speed, efficiency and production time, the NSK K1™ Lubrication Unit (referred to as NSK K1 hereafter) enables maintenance-free operation for more than 5 years or 10,000 km. NSK K1 not only provides maintenance efficiency, but also reduces total operating cost. Therefore no maintenance, unforeseen or scheduled, is required to keep machines running efficiently.

This whitepaper identifies why the NSK K1 should be added to NSK Linear Motion components across multiple industries operating under harsh conditions.

The Design Challenge

Improper lubrication is one of the main causes attributed to premature bearing failure. Lubrication maintenance is vital to keep a machine running efficiently. NSK K1 is an outstanding lubrication method that contains a large amount of lubricant housed in a porous synthetic resin. This design constantly supplies fresh oil to environments where grease replenishment is undesirable or may be easily washed away.

Solution Overview

NSK K1 lubrication technology can be installed on NSK linear guide, ball screw, Monocarrier™ linear actuator, and Robot Module™ product lines. Refer to **Figure 1** and **Figure 2** showing NSK K1 on a linear guide and **Figure 3** and **Figure 4** demonstrates ball screws equipped with NSK K1.

Figure 1

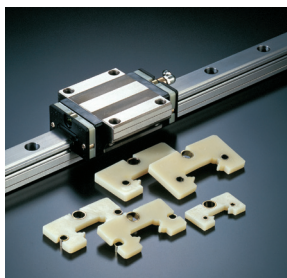


Figure 2

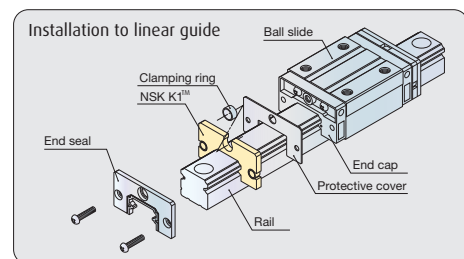
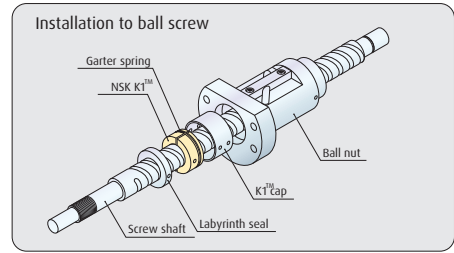


Figure 3



Figure 4



Reduced Cost

Four major cost reductions are identified when NSK K1 are in use. First, significant cost decrease related to lubricant expense. Second, reduction of maintenance personnel costs. Third, NSK K1 acts as a barrier and reduces contaminant emission which prolongs coolant life. Last and possibly the most important, if machines are up and running, then parts are being produced. And as a result, customer service can quote shorter lead time which satisfies the customer and leads to repeat business.

Long Operating Life

Refer to **Figure 5** to see how both linear guide and ball screw with NSK K1 performed in comparison to those that operated without lubricant. The linear guide with no lubricant was damaged after 79 km whereas the use of NSK K1 allowed it to perform more than 50,000 km. Likewise, an un-lubricated ball screw was damaged after only 8 km compared to more than 23,600 km with use of NSK K1.

Figure 5

Comparison test between NSK K1™ and standard seal



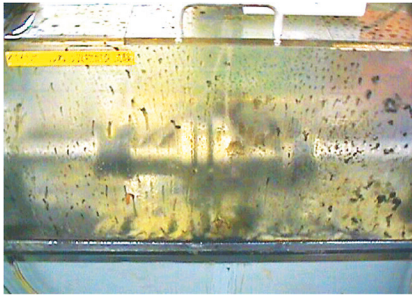
Sample: LH30 (slight preload)
 Lubrication: 1) Only NSK K1™
 2) No lubricant
 Load: none
 Speed: 60 m/min
 Stroke: 750mm

Sample: Shaft dia. 20 mm, lead 20 mm
 Lubrication: 1) Only NSK K1™
 2) No lubricant
 Load: none
 Speed: 40 m/min
 Stroke: 450mm

Operating with no lubricant, linear guide and ball screw are unable to travel very far before premature failure results. When no lubrication or an insufficient amount is applied to the linear bearing during operation, metal-to-metal contact occurs. When two metal surfaces slide against each other, friction is produced resulting in heat. Frictional heat left unnoticed leads to premature bearing failure.

Over time small abrasions have formed along ball screw shaft **Figure 6**. Scoring, flaking, peeling, smearing, pitting, fretting and brinelling are all common surface damages that can result from poor lubrication.

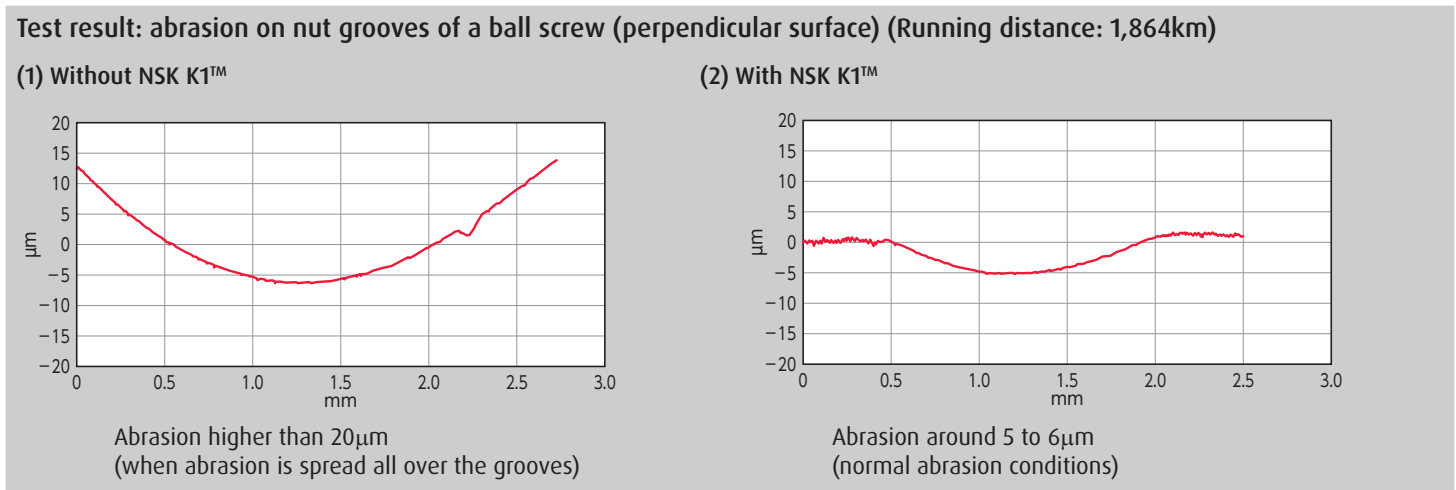
Figure 6



Sample: Screw shaft dia. 40 mm, lead 10 mm
Circuit: 2.5 x 1
Load: 3.9 KN
Speed: 2,000 min⁻¹ (20 m/min)
Stroke: 340 mm
Contamination: Dropped contaminants on BS shaft periodically.
FCD45 particle 115 MESH added at coolant
Coolant dilution 30:1
Volume of contaminant: Coolant 3,600 cm³ +
casting particles 1.8 g/day

However, after installing NSK K1, surface damage was reduced by 75% **Figure 7**.

Figure 7



Handling Instructions

Please follow these handling instructions to ensure long, operating life.

- Maximum operating temperature: 50° C (122° F)
- Maximum peak temperature: 80° C (176° F)
- Please keep refrigerated if not installed immediately.
- Avoid storing in direct sunlight.
- Don't leave in close proximity to grease-removing organic solvents such as hexane, thinners, etc.
- Never immerse in kerosene or rust preventative oil containing kerosene.
- Safe to use with water based cutting oil, oil-based cutting oil and grease (mineral oil-AS2, ester-PS2).

Ideal for Heavily Contaminated Environments

Use of NSK K1 significantly increases machinery life even in environments exposed to water or other contaminants. NSK K1 technology can be used across many different industries for several different types of applications including welding, lathe and drilling applications utilized in machine tool and woodworking operations where high contamination is present.

In woodworking applications, lubricant is absorbed by wood chips. To overcome this challenge, NSK K1 technology is added to a standard seal. Two times longer life is achieved in comparison to using a standard double seal only. **Figure 8**. Dust emission is also reduced with the use of NSK K1 **Figure 9**.

Sample: NH30AN (preload Z1)
 Travel Speed: 24 m/min
 Stroke: 400 mm
 Load: 490 N/Slide

Seal specifications/lubricant: Standard double seal + AS2 Grease
 NSK K1 + standard seal + AS2 Grease

Figure 8

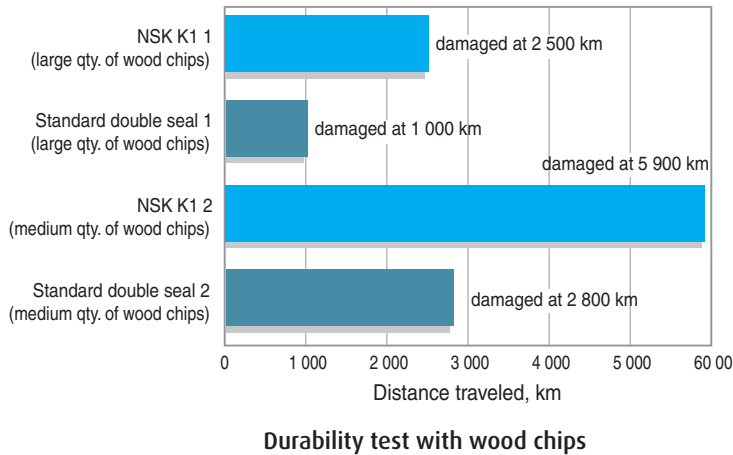
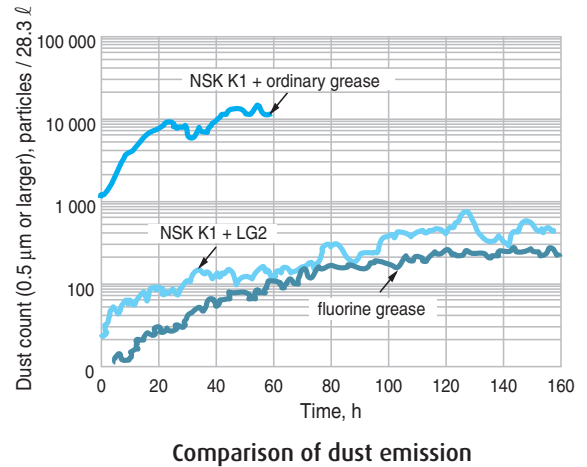


Figure 9



For food processing and medical equipment, NSK has developed a NSK K1 that is FDA-compliant for linear guide applications. Similar to the standard NSK K1, it is made up of a porous synthetic resin that disperses lubricant along the rail when in motion. All materials used are compliant with the US Food and Drug Administration (FDA). The porous synthetic resin provides a controlled supply of lubricant thus preventing an overflow of oil. It can withstand being submersed in water as well as being exposed to frequent wash downs.

The highest grade of H1 grease, USDA standard, is used for NSK K1. This grease type for food processing machines offers superior water resistance and anti-rust capability. NSK K1 FDA compliant version is available in these Linear Guide models **Figure 10**.

Figure 10

NH Series	NH12, NH15, NH20, NH25, NH30, NH35
NS Series	NS15, NS20, NS25, NS30, NS35
LW Series	LW17, LW21, LW27, LW35
PU Series	PU09, PU12, PU15
LU Series	LU09, LU12, LU15
PE Series	PE09, PE12, PE15
LE Series	LE09, LE12, LE15

Case Study

The bakery was using a competing brand of linear guides with food-grade grease that was under-performing and causing excessive maintenance, downtime and lost production. NSK recommended installing NH-NS Series Stainless Steel Linear Guides with food grade grease and FDA compliant NSK K1. As a result, the linear guides performed 10 times longer and at a 20% faster production speed than the competitor's linear guide.

Once all 5 machines were interchanged to NSK, the replacement interval time decreased from 3 weeks to every 32 weeks. This significantly reduced downtime and maintenance for the bakery resulting in an annual cost savings of \$229,120.

Annual Cost Saving Breakdown

Issue

› Replacement Cost: Cost of linear guide 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 linear guide 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 NSK K1 Lubrication Unit

The NSK K1 can be added to NSK ball screw, linear guide, Monocarrier™ linear actuator and Robot Module™ product lines to increase operating life, reduce cost and deliver maintenance-free convenience. A wide variety of applications in machine tool, food & beverage, medical, packaging equipment, semiconductor, and woodworking equipment have benefited from installing NSK K1 technology.

For additional technical information, publications featuring NSK K1 or assistance with machinery/equipment design requiring linear motion solutions contact NSK Americas at 1.888.446.5675 or visit us at www.nskamericas.com.