LUBRICATION UNIT NSK K1™
USED ON NSK LINEAR GUIDES™, BALL SCREWS, AND MONOCARRIERS™
NSK K1™ lubrication unit equipped on a NSK linear guide, ball screw or Monocarrier™ is an outstanding new lubrication method. A newly developed porous synthetic resin contains large volume of lubricant oil that seeps out and enhances lubricating function.

› NSK K1™ lowers machine operation cost, and reduces impact on the environment.
› NSK K1™ is a lubrication 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 NSK K1™ constantly supplies fresh oil which seeps from the resin.

You can achieve the following:
- Long-term maintenance-free (cost reduction)
- Long life in severe environments
- Environmentally sound clean lubrication system

Lubricant oil and polyolefin combined and molded into one unit
- Containing 70% of lubrication oil
- Supplies lubricant oil for long periods of time (Service life: in excess of 100,000 hours)

NSK Linear Guides equipped with NSK K1™

Features of NSK Linear Guides equipped with NSK K1™
› With the NSK K1™ lubrication unit, maintenance is unnecessary for more than five years or 10,000 km.
› Simply attach the unit inside the standard end seal.
› The NSK K1™ lubrication unit is also available for use with food machinery, medical equipment and peripherals in environments with strict hygienic or sanitation restrictions. See page 5 for details.

Ball Screws equipped with NSK K1™
A lubrication system equipped with the NSK K1™ lubrication unit is maintenance free for more than five years or 10,000 kilometers.

Conventional system
Supplying oil using a lubrication unit and centralized piping

New lubrication system
Using the NSK K1™ lubrication unit

Advantages
› A reduction in expenditure on oil or grease cost by making it unnecessary to replenish lubricants for an extended period
› A reduction in personnel costs for regular maintenance
› A reduction in the cost of designing and replenishing piping or equipment, parts expenditures, and lead time for assembly
› A reduction in the cost for coolants and in processing oil waste
  (No lubricant contamination = Prolonged life of coolants)

Comparison test between NSK K1™ and standard seal

(1) Linear guide

<table>
<thead>
<tr>
<th>Running distance, km</th>
<th>with NSK K1™</th>
<th>No lubricant</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Running 50,000 km (still able to run)</td>
<td>Damaged at 79 km</td>
</tr>
<tr>
<td>10,000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>20,000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>30,000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>40,000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>50,000</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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

(2) Ball screw

<table>
<thead>
<tr>
<th>Running distance, km</th>
<th>with NSK K1™</th>
<th>No lubricant</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Running 23,600 km (still able to run)</td>
<td>Damaged at 8 km</td>
</tr>
<tr>
<td>5,000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10,000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>15,000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>20,000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>25,000</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Sample: Shaft dia. 20 mm, lead 20 mm
Lubrication: 1) Only NSK K1™
2) No lubricant
Load: None
Speed: 40 m/min
Stroke: 450 mm
Long Life in Severe Environments

Use of the NSK K1™ lubrication unit significantly prolongs the life of your machinery, even in severe contaminated environments or undesirable environments for lubrication.

Advantages

› A reduction in maintenance cost, including repair parts and personnel
› Longer time between repairs ➔ shortened down-time on the production line ➔ Improved productivity

Example of severe environments

› Contaminated environments: machine tools, welding machines, etc.
› Environments where oil and grease absorbing dust is produced: woodworking machines, textile machines, papermaking machines, printing machines, etc.
› Environments where lubricant is washed away: machines that are washed away entirely by water, machines that are exposed to rain or water.

Note: Rust preventive treatment is required for corrosive environments.

Test result of ball screws in contaminated environments

Sample: Screw shaft dia. 40 mm, lead 10 mm
Circuit: 2.5 × 1
Lubrication:  1) AS2 Grease (packed before operation only)
               2) AS2 Grease (packed before operation only) + NSK K1™
Load: 3.9 kN
Speed: 2,000 min⁻¹ (20 m/min)
Stroke: 340 mm
Contamination: Dropped contaminants onto screw 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

Test result: abrasion on nut grooves of a ball screw (perpendicular surface)  (Running distance: 1,864 km)

(1) Without NSK K1™
   Abrasion higher than 20 µm
   (when abrasion is spread all over the grooves)

(2) With NSK K1™
   Abrasion around 5 to 6 µm
   (normal abrasion conditions)

Use of the NSK K1™ lubrication unit has reduced abrasion of ball screws by 75%.
Environmentally Sound Clean Lubrication System

By using the NSK K1™ lubrication unit, you can solve these problems and achieve a clean and environmentally sound machinery / equipment system.

**Merit**

› Suitable for machinery or equipment used where exposed lubricants should be avoided, such as food processing machinery, medical equipment, or engineering and textile machinery.
› Suitable for machinery or equipment that requires extremely high levels of cleanliness, such as semiconductor and LCD fabrication-related equipment.
› Improvement of work environment.

**Adjacent areas for NSK K1™ installed linear guide**

![NSK K1™ installed linear guide](image)

Replenishing grease is not required, so machines are kept clean.

**Precautions for handling**

To maintain high functionality of the NSK K1™, observe the following precautions:

1. **Temperature range for use:**
   - Maximum temperature in use: 50°C
   - Momentary maximum temperature in use: 80°C

2. **Chemicals that should not come into contact with NSK K1™:**
   - Do not leave the NSK K1™ in an organic solvent, such as hexane and thinner that remove oil, or rust preventive oil that contains white kerosene.

Note: Water-type cutting oil, oil-type cutting oil, mineral-oil type grease and ester-type grease do not damage NSK K1™.
NSK Linear Guides for Food Processing and Medical Equipment in Sanitary Environments

The NSK K1™ lubrication unit for food processing and medical equipment is safe and secure. NSK K1™ FDA-compliant material is used for the lubrication unit, so it is used without concern for food processing and medical equipment.

- The NSK K1™ lubrication unit for food processing and medical equipment is a phenomenal new material seal that is safe and secure.
- The newly developed porous synthetic resin contains abundant lubricant.
- With the basic functions of highly praised NSK K1™ for general industry, more sophisticated materials make it applicable in food and medical equipment.
- It also offers easy installation, mounted inside the standard end seal (rubber).

**Features of NSK K1™ Lubrication Unit for Food and Medical Equipment**

- **Very safe to handle:**
  Uses highly safe materials that are compliant with the US Food and Drug Administration’s (FDA) hygiene standards for food additives.

- **Environmentally sound:**
  The newly developed porous synthetic resin provides a controlled supply of lubricant, preventing the dispersion of oil in sanitary environments.

- **Resistant to harsh environments:**
  It is durable not only under normal environments, but also under harsh environments, such as machinery submersed in water.

**Features of NSK Linear Guides for Sanitary Environments**

- The highest grade of category H1 grease of USDA standard is used for NSK K1™ lubrication unit.
  - *category H1: Lubricants permitted for use where there is possibility of incidental food contact*
  - *USDA: USDA (The United States Department of Agriculture)*

- Features of grease for food processing machines:
  - This grease is approved by USDA H1. (National Science Foundation [NSF] carries out certification for USDA.)
  - Superb water resistance and antirust capability
  - Superb wear resistance
  - Applicable for a centralized oiling system

- **Appropriate volume of grease:**
  A supply of appropriate volume of grease reduces grease draining and scattering, and maintains a clean environment.

The table below shows available models.

<table>
<thead>
<tr>
<th>NH Series</th>
<th>NH12, NH15, NH20, NH25, NH30, NH35</th>
</tr>
</thead>
<tbody>
<tr>
<td>NS Series</td>
<td>NS15, NS20, NS25, NS30, NS35</td>
</tr>
<tr>
<td>LW Series</td>
<td>LW17, LW21, LW27, LW35</td>
</tr>
<tr>
<td>PU Series</td>
<td>PU09, PU12, PU15</td>
</tr>
<tr>
<td>LU Series</td>
<td>LU09, LU12, LU15</td>
</tr>
<tr>
<td>PE Series</td>
<td>PE09, PE12, PE15</td>
</tr>
<tr>
<td>LE Series</td>
<td>LE09, LE12, LE15</td>
</tr>
</tbody>
</table>
Introduction of Performance by Use: 
Automotive Manufacturing Equipment

Maintenance Free, Long Life even in Severe Environments

Actual results from welding machines, the most severe environment in automotive plants

Operating conditions:
Sample: LH300200ELC1-PCZ
No.1: Double seal + Protector (no NSK K1™)
No.2: NSK K1™ attached + Single seal + Protector
Tested on the same welding machine at the same place in automotive production line
Sample No. 1: 10.5 month operation
Sample No. 2: 13 month operation

Comparison after running:
Sample No. 1 (without NSK K1™):
Rail and ball slide raceways and balls showed rust and extensive deterioration
Sample No. 2 (with NSK K1™):
Rail and ball slide raceways and balls had no rust and only slight deterioration

Merit

 › Reduced expense for lubricants (see graph to the right)
 › No oil or grease supply systems required
      Reduced equipment cost
 › Improved machine design time and efficiency
      No piping design required
 › Long-term maintenance free
      Reduced maintenance cost
 › Better for the environment
      NSK K1™ reduces lubricant consumption, minimizes waste oil

Applications

 › Lifter and carrier
 › Multi-tier stock systems
 › Sorting systems
 › Engine/chassis decking systems
 › Underbody line welding machines
 › Body line conveyor systems
 › Marking machines
 › Assembly machines
 › Material handling systems
 › Differential gear grinding machines
 › Assembly vibration testers

Comparison of lubricant consumption

Estimated oil consumption in the test equivalent to 5 years running (for 4 LH45 slides)

- 0.3 cm³ × 16 h/day
- × 340 days/year × 5 years
- × 4 slides = 32,640 cm³
- 59 cm³ × 4 slides
- ≈ 236 cm³

Ball deterioration

Sample No. 1 (without NSK K1™)
Sample No. 2 (with NSK K1™)

Rail raceway deterioration

Sample No. 1 (without NSK K1™)
Sample No. 2 (with NSK K1™)
High-Load Life Test Using Cutting Coolant which is Contaminated with Cast Iron Particles

3 samples of different lubricant conditions

Test conditions:
Sample: LY45BN (Preload Z4)
Load: 9,800 N per one ball slide
Preload: 4,400 N
Feed: Average 24 m/min
Stoke: 400 mm
Contamination: Coolant dilution 30:1
FCD45 particles 115 MESH (125 µm or less) added at 5% (by weight)
Pattern: 2 days in coolant (ball grooves of rail are immersed), 5 days no coolant

Friction force change

Test results

<table>
<thead>
<tr>
<th>Sample</th>
<th>Lubricating condition (*)</th>
<th>Broken end cap</th>
<th>Flaking</th>
<th>Lost Preload</th>
<th>Result Distance (km) Running year (”)</th>
</tr>
</thead>
<tbody>
<tr>
<td>No.1 Grease only</td>
<td>Yes</td>
<td>Test stopped</td>
<td>No</td>
<td>Yes</td>
<td>End cap broke prematurely due to inadequate means of lubrication and particles. 600 km, 0.8 years.</td>
</tr>
<tr>
<td>No.2 NSK K1™ (4 pcs.) + Grease</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Running uninterrupted over 3,600 km, 5 years.</td>
<td></td>
</tr>
<tr>
<td>No.3 Oil only</td>
<td>No</td>
<td>Slight</td>
<td>Yes</td>
<td>Shortened life because of particle and inadequate means of lubrication. 3,000 km, 4.1 years.</td>
<td></td>
</tr>
</tbody>
</table>

(*) No replenishment of grease to sample No.1 and No.2 during test.
(”) Running year is calculated by 720 km/year (average 3 m/min × 16 hr/day × 250 days/year).

Merit

› Reduced expense for lubricants (see graph to the right)
› No oil or grease supply systems required
› Improved machine design time and efficiency
› Better for the environment
› NSK K1™ reduces lubricant consumption, minimizes waste oil

Applications

› Machining centers › NC Lathes › Water jet cutter
› Pallet changer › Laser processing machines (X and Y axes)
› Telescopic cover for horizontal machining center

Comparison of lubricant consumption

Estimated oil consumption in the test equivalent to 5 years running (for 4 LA45 slides)
Long Life even with Wood Chip Contamination

Life is 2 times longer than standard double seals in woodworking machines

Comparison test between NSK K1™ and standard double seal

Test conditions:
- Sample: LH30AN (Preload Z1)
- Feed rate: 20 m/min
- Stroke: 400 mm
- Lubrication: Standard double seal - AV2 grease
  - NSK K1™ - NSK K1™ + AV2 grease
- Load: 490 N per one ball slide

Wood chip contamination: Set the product in the box with bottom area A, then put 240 g of wood chips on the rails. Reapplied removed wood chips to rails 3 times/day.
- [High volume of chips]: A = 145 mm (width) × 700 mm (length)
- [Medium volume of chips]: A = 170 mm (width) × 700 mm (length)

Test results (high volume of chips)

Test results (medium volume of chips)

Merit

- No oil or grease supply systems required
  - Reduced equipment cost
- Improved machine design time and efficiency
  - No piping design required
- Better for the environment
  - NSK K1™ reduces lubricant consumption, minimizes waste oil

Applications

- Router
- Lumber cutting, groove making machines
- Pre-cutting machines
- Unmanned lumbering machines
Low Particle Emission

Combining the NSK K1™ with LG2 grease for low particle emission is comparable to using vacuum grease.

Test conditions:
Sample: LS20
Speed: 36 m/min

High Performance Lubrication - Maintenance free

Over 30,000 km running with only NSK K1™.
Improved performance can be expected when used with the LG2 Grease.

Endurance test without additional lubrication

Test conditions:
Sample: LH30AN
Preload: Z1, Z3

<table>
<thead>
<tr>
<th>Speed (m/min)</th>
<th>Stroke (mm)</th>
<th>Load (N/1 ball slide)</th>
</tr>
</thead>
<tbody>
<tr>
<td>High speed</td>
<td>200</td>
<td>1,800</td>
</tr>
<tr>
<td>Medium speed</td>
<td>60</td>
<td>750</td>
</tr>
</tbody>
</table>

Change of dynamic friction force (100% at the beginning)

Applications

› LCD substrates polishing machines
› LCD glass substrates transporting machines
› LCD glass substrates testing equipment
› Thin film processing equipment for semiconductors
› Washing machines
› Full automatic wafer mounters
› Washing section of the wafer polishing machines
› Carrier arm section of logic handler
› CMP
**Keeps Equipment and Adjacent Areas Clean**

Wear life is 3 times longer than normal seals under wet conditions.

**Endurance test in water**

**Test conditions:**
Sample: LS30 stainless steel  
Preload: Z1  
Load: 4,700 N per one ball slide  
Stroke: 400 mm  
Speed: 24 m/min  
Lubrication: Grease full pack  
(Consistency: 280, Viscosity: 580 cst)  
Water exposure: Run in water 1 day per week.

**Good Operability (Stable Dynamic Friction Force)**

Change of oil supply of NSK K1™ and dynamic friction force

**Test conditions:**
Sample: LH30AN, preload Z1 (only with NSK K1™)  
Stroke: 800 mm  
Speed: Average 38.4 m/min  
Load: None

**Applications**

› Sample preparation systems  
› Blood analyzer  
› Medical examination tables and bed transfer equipment  
› Medical scanner  
› Analytic equipment  
› Food processing machines  
› Food conveyor
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