LUBRICATION UNIT NSK K1™
USED ON NSK LINEAR GUIDES, BALL SCREWS, AND MONOCARRIERS™

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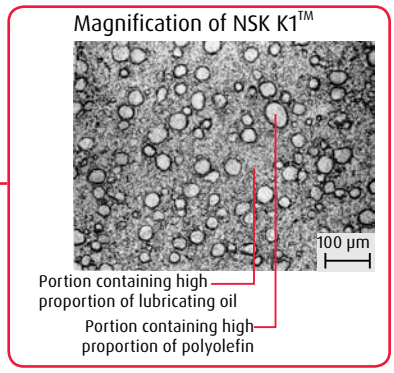
LUBRICATION UNIT NSK K1™

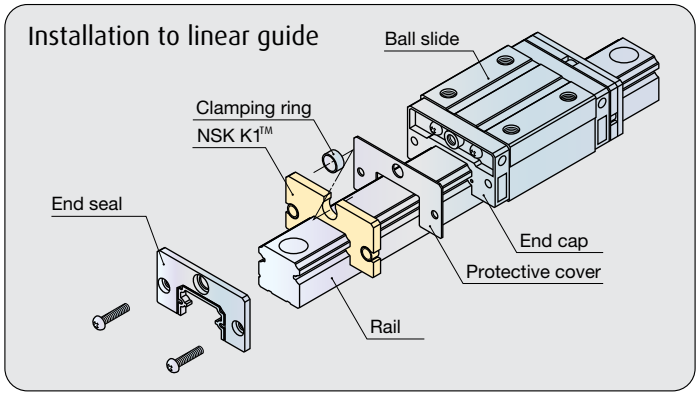
NSK K1™ lubrication unit equipped on a NSK linear guide, ball screw or Monocarrier™ is an outstanding lubrication method. The porous synthetic resin contains a 70% volume of lubricant oil that seeps out onto the raceway and enhances the lubricating function.

You can achieve the following:

- Long-term maintenance-free (cost reduction)
- Long life in severe operating conditions
- Reduced impact on the environment



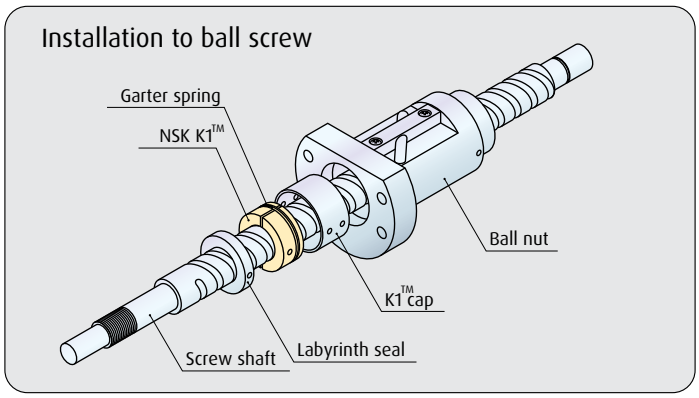
NSK LINEAR GUIDES EQUIPPED WITH NSK K1™



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 behind 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™

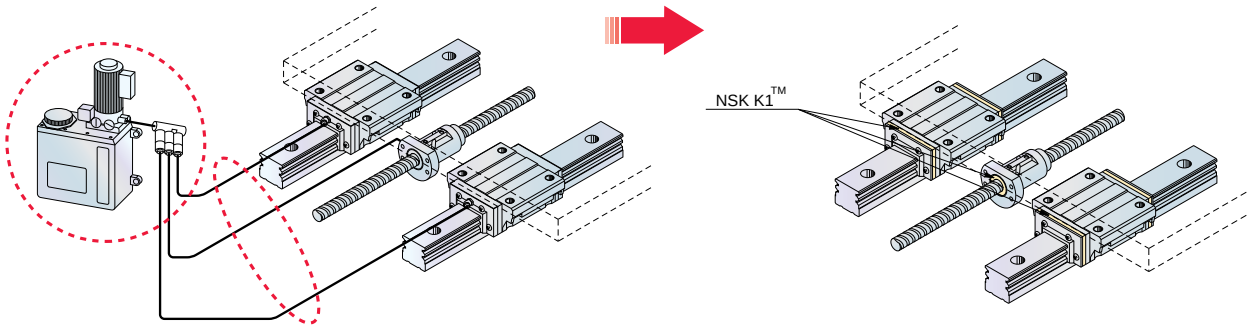


LONG-TERM MAINTENANCE FREE (COST REDUCTION)

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

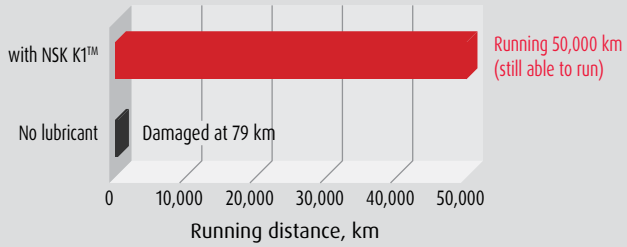


ADVANTAGES

- 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)

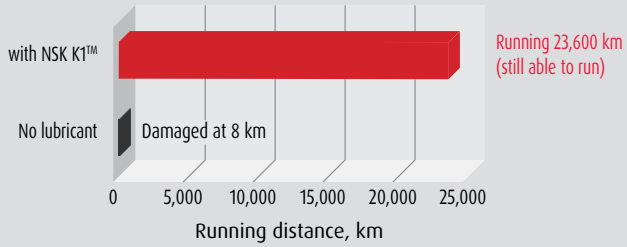
COMPARISON TEST BETWEEN NSK K1™ AND STANDARD SEAL

(1) Linear guide



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

(2) Ball screw



Sample: Shaft dia. 20 mm, lead 20 mm
Lubrication 1) Only NSK K1™
2) No lubricant
Load: None
Speed: 40m/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 by coolant, water or exposed to the elements.

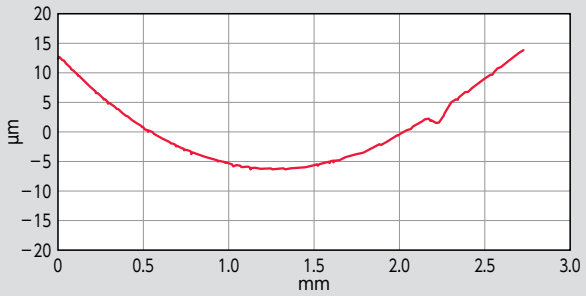
Note: Rust preventive treatment is required for corrosive environments.

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 cm^3 + casting particles 1.8 g/day

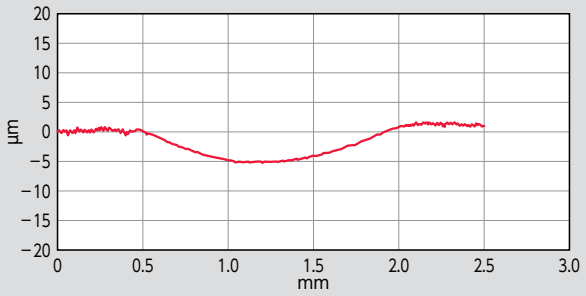
Test result: abrasion on nut grooves of a ball screw (perpendicular surface) (Running distance: 1,864 km)

(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%.

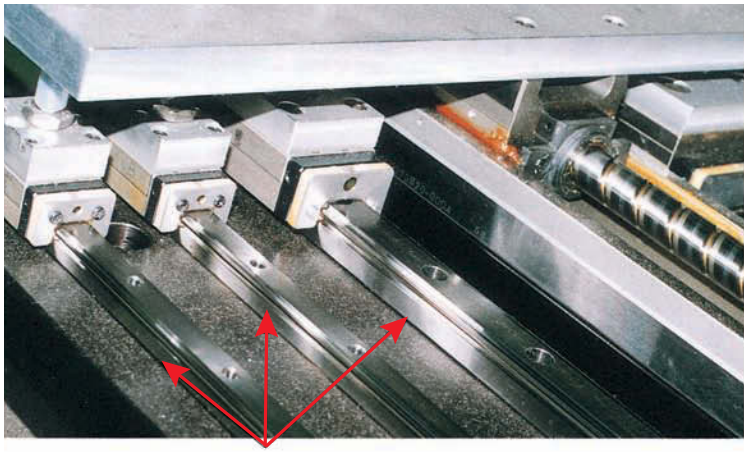
ENVIRONMENTALLY SOUND CLEAN LUBRICATION SYSTEM

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
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 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 behind 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.

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.

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

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

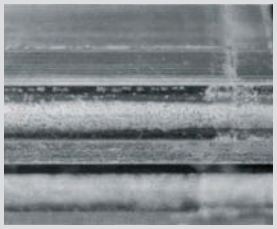
Ball deterioration

Sample No. 1 (without NSK K1™)

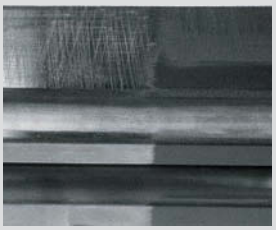
Sample No. 2 (with NSK K1™)

Rail raceway deterioration

Sample No. 1 (without NSK K1™)



Sample No. 2 (with NSK K1™)

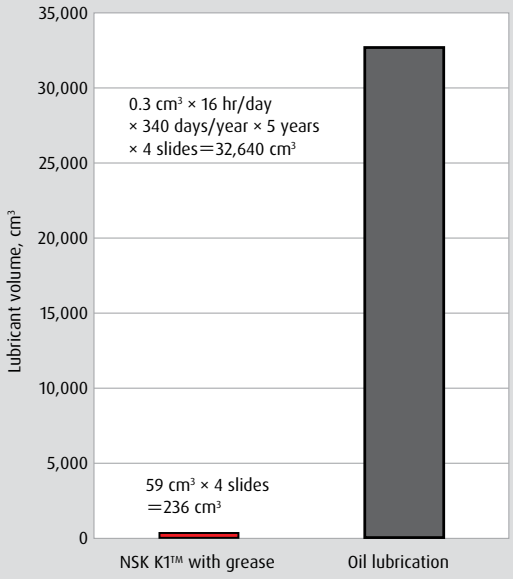


MERIT

- 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

Comparison of lubricant consumption

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



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

INTRODUCTION OF PERFORMANCE BY USE: MACHINE TOOLS

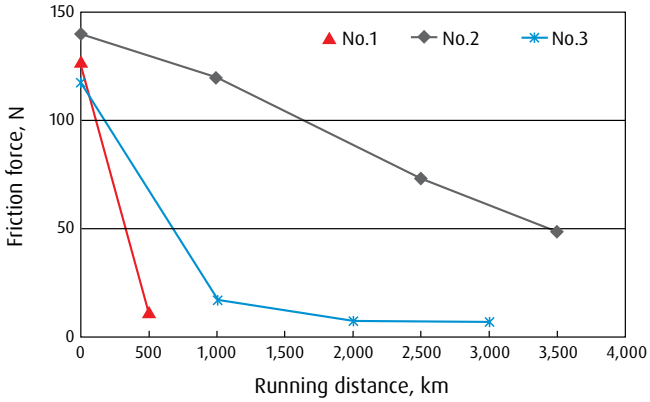
HIGH-LOAD LIFE TEST USING CUTTING COOLANT WHICH IS CONTAMINATED WITH CAST IRON PARTICLES

3 samples of different lubricant conditions

Test conditions:

Sample:	LY45BN (Preload Z4)		
Load:	9,800 N per one ball slide		
Preload:	4,400 N	Grease:	AV2
Feed:	Average 24 m/min	Stroke:	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

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

(*1): No replenishment of grease to sample No.1 and No.2 during test.
(*2): 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
  Reduced equipment cost
- Improved machine design time and efficiency
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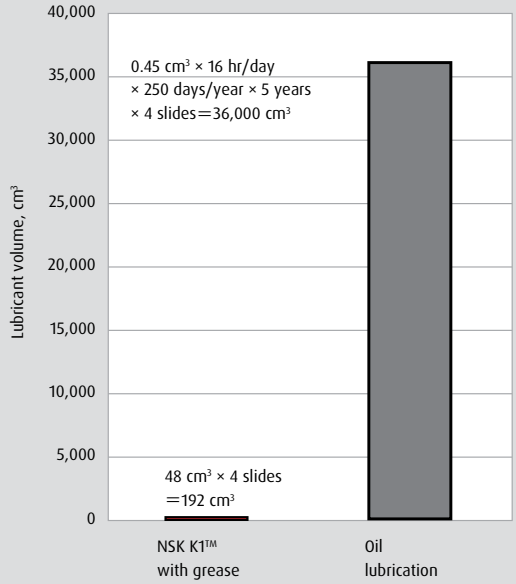
  NSK K1™ reduces lubricant consumption, minimizes waste oil

Comparison of lubricant consumption

Estimated oil consumption in the test equivalent to 5 years running (for 4 LA45 slides)



APPLICATIONS

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

INTRODUCTION OF PERFORMANCE BY USE: WOODWORKING MACHINES

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

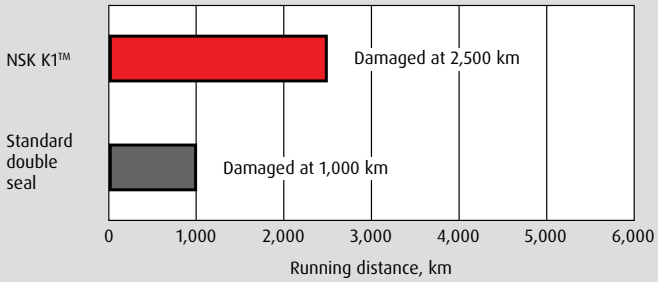
Test conditions:

Sample: LH30AN (Preload Z1)
Feed rate: 20 m/min
Stroke: 400 mm
Lubrication: Standard double seal - AV2 grease
NSK K1™ - NSK K1™ + AV2 grease

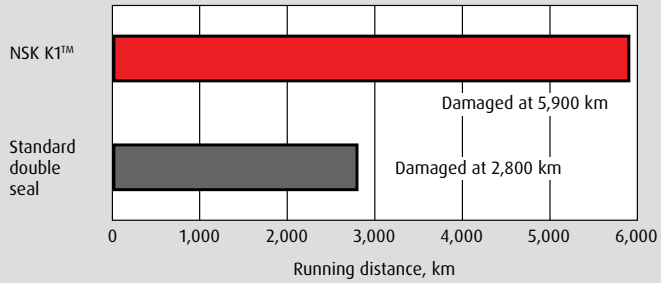
Load: 490 N per one ball slide
Wood chip contamination: Set the product in the box with bottom area A, then put 240 g of wood chips on the rails. Reapplied removed wood chips to rails 3 times/day.
[High volume of chips]: A = 145 mm (width) × 700 mm (length)
[Medium volume of chips]: A = 170 mm (width) × 700 mm (length)

Running test in wood chips

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

INTRODUCTION OF PERFORMANCE BY USE: SEMICONDUCTOR / LCD MANUFACTURING EQUIPMENT

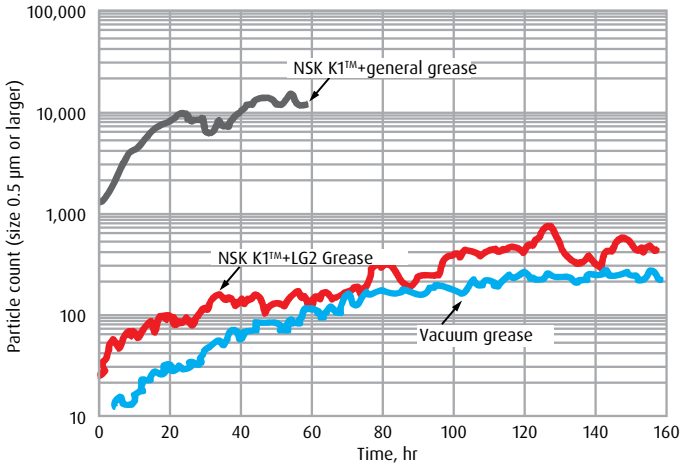
LOW PARTICLE EMISSION

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

Comparison of particle emission characteristics



HIGH PERFORMANCE LUBRICATION - MAINTENANCE FREE

Over 30,000 km running with only NSK K1™.

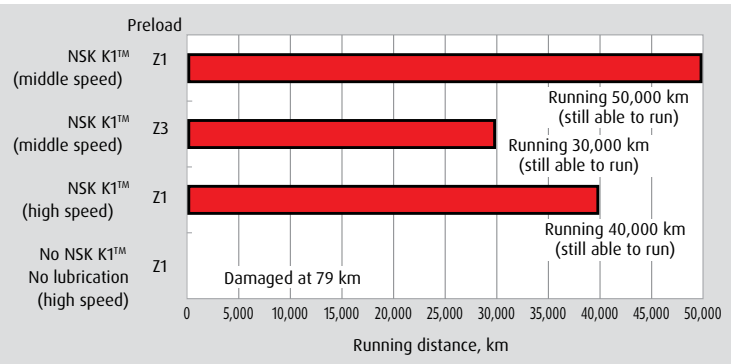
Improved performance can be expected when used with the LG2 Grease.

Endurance test without additional lubrication

Test conditions:

Sample: LH30AN
Preload: Z1, Z3

	High speed test	Medium speed test
Speed:	200 m/min	60 m/min
Stroke:	1,800 mm	750 mm
Load:	63 N/1 ball slide	None

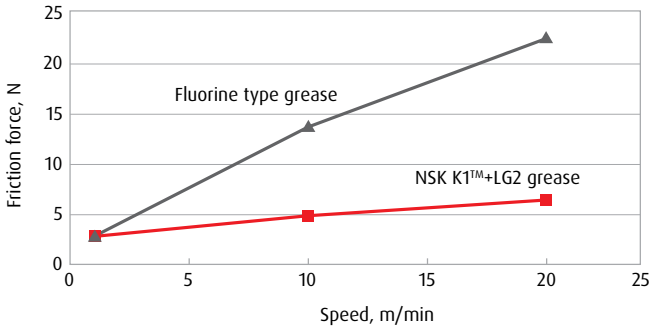


GOOD OPERABILITY (STABLE DYNAMIC FRICTION FORCE)

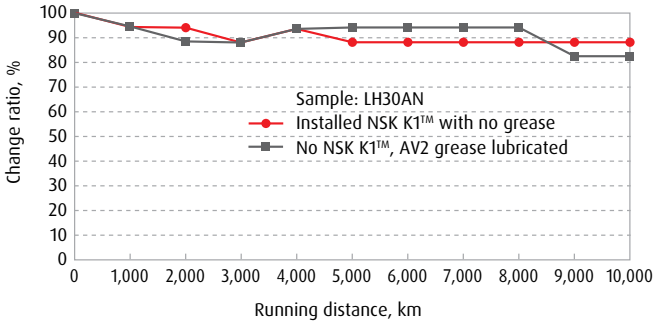
Dynamic friction force is 1/3 of fluorine type grease (at 20 m/min).

Test conditions:

Sample: LS20AL
Preload: Z1



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

INTRODUCTION OF PERFORMANCE BY USE: FOOD PROCESSING, MEDICAL EQUIPMENT

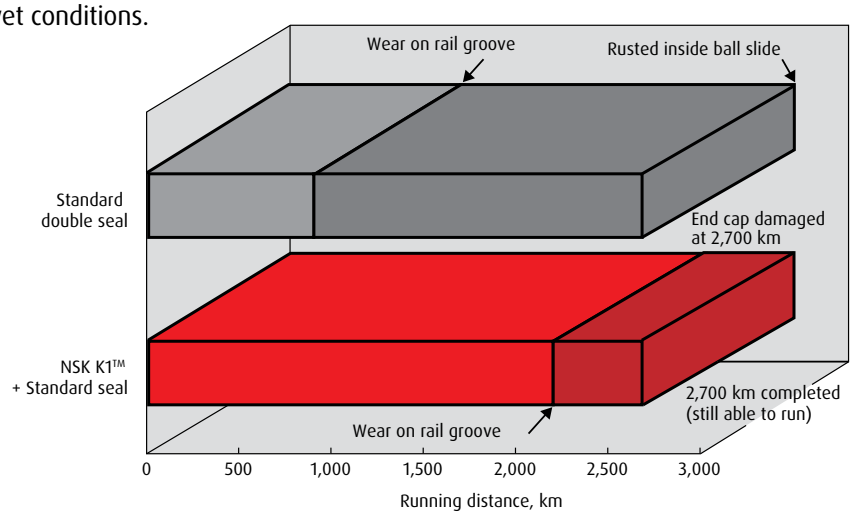
KEEPS EQUIPMENT AND ADJACENT AREAS CLEAN

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.

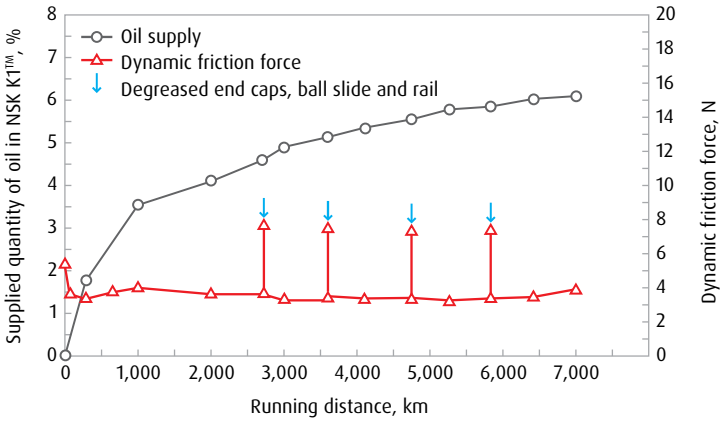


GOOD OPERABILITY (STABLE DYNAMIC FRICTION FORCE)

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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