

Technical  
Reference



# Smooth Silent Ecological

## Special Environmental Specifications of THK Linear Motion Systems



For details, visit THK at [www.thk.com](http://www.thk.com)

\*Product information is updated regularly on the THK website.

**THK CO., LTD.**  
TOKYO, JAPAN

CATALOG No.272-7E

# Special Environmental Specifications of

## **THK** Linear Motion Systems

The linear motion systems used in special environments such as semiconductor production systems, liquid crystal production systems, health care equipment and food processing machinery are the product of roughly 30 years of technology and a vast amount of experience.

This brochure provides an introduction to the special environmental specifications products created by taking full advantage of **THK**'s proprietary Caged Ball Technology, materials technology, lubrication technology and surface treatment technology in order to effectively respond to the increasingly diversified needs of today.



# 1 Clean Rooms

In clean environments such as the environments found in clean rooms, it is necessary to reduce the generation of dust by linear motion systems as well as enhance rust preventive performance since rust preventive films cannot be used. In addition, depending on the degree of cleanliness of the clean room, it is also necessary to use a dust collector.

## Generation of Dust from Linear Motion Systems

### Measures against dust generation caused by splattering of grease:

#### **THK AFE-CA Grease and AFF Grease**

Grease resulting in low generation of dust is used and is suitable for clean environments.

### Measures against dust generation caused by production of metal wear fragments:

#### **LM Guide with Ball Cage**

The use of the LM Guide with Ball Cage reduces the level of metal wear fragments produced by eliminating friction between the balls, thereby making it possible to suppress the generation of dust.

## Rust Prevention

### Material countermeasures:

#### **Stainless Steel LM Guide**

This LM Guide uses martensite stainless steel that is effective in prohibiting rust.

#### **High Corrosion Resistance LM Guide**

The LM Rail uses austenite stainless steel resulting in a high degree of rust preventive effects.

### Surface treatment countermeasures:

#### **THK AP-C Treatment, AP-CF Treatment and AP-HC Treatment**

Surface treatment (plating) of linear motion systems results in improved rust prevention capabilities.

# 2 Vacuum

In vacuum environments, it is necessary to select products having excellent rust prevention capabilities as countermeasures against dispersion of gases released from resins and splattering of grease since rust preventive oil cannot be used.

### Measures against gas released from resins:

#### **Stainless Steel LM Guide**

Stainless steel is used for the material of the end plates of the LM block (through which plastic balls circulate) to reduce the levels of released gas.

### Measures against grease splattering:

#### **Vacuum Grease**

When general-purpose grease is used in a vacuum environment, the oil component of the grease ends up dispersing resulting in a loss of lubricity. Consequently, vacuum grease is used that uses a fluorine-based oil having a low vapor pressure for the base oil.

### Rust preventative countermeasures:

#### **Stainless Steel LM Guide**

The stainless steel LM Guide is used in vacuum environments due to its excellent rust preventative effects.

#### **High-Temperature LM Guide**

The high-temperature LM Guide is used in cases of being subjected to high temperatures such as during baking, etc. because of its excellent heat resistance and corrosion resistance.

### 3 Oil-Free

In environments susceptible to liquid lubricants, a lubrication method other than grease or oil is required.

#### Dry Lubricant

##### Dry Lubrication S-Compound Film

Dry Lubrication S-Compound Film is a fully dry lubricant developed for use under atmospheric to high-vacuum environments.

It has superior characteristics in load carrying capacity, wear resistance and sealability to other lubrication systems.

### 4 Corrosion Resistance

Similar to the case of use in clean rooms, corrosion resistance is enhanced by selecting appropriate materials and surface treatment.

#### Material countermeasures:

##### Stainless Steel LM Guide

This LM Guide uses martensite stainless steel that is effective in prohibiting rust.

##### High Corrosion Resistance LM Guide

The LM Rail uses austenite stainless steel resulting in a high degree of rust preventative effects.

#### Surface treatment countermeasures:

##### **THK** AP-C Treatment, AP-CF Treatment and AP-HC Treatment

Surface treatment (plating) of linear motion systems results in improved rust prevention capabilities.

### 5 High Speed

In high-speed environments, an optimum lubrication method is required that suppresses the generation of heat during high-speed motion and improves the retention capabilities of the grease.

#### Measures against heat generation:

##### LM Guide with Ball Cage

Heat generation is reduced as a result of the ball cage eliminating friction between the balls. Moreover, since the retention capabilities of the grease are improved, a long service life and outstanding high-speed performance are achieved.

##### High-Speed Ball Screw with Ball Cage (DN value up to 160,000: Model SBK)

The use of a ball cage realizes the ideal ball circulation structure, enabling high-speed feeding unable to be realized with conventional products.

##### **THK** AFG Grease, AFA Grease, AFJ Grease

The use of grease capable of suppressing heat generation during high-speed use while also offering excellent lubricity makes it possible to achieve high-speed feeding.

#### Lubrication countermeasures:

##### Lubricator QZ

Lubricator QZ makes it possible to significantly extend lubrication maintenance intervals by compensating for lost oil. Since only the minimal amount of lubricating oil is applied to the rolling surface, the surroundings are not soiled resulting in a lubrication system that is environmentally friendly.

## 6 High Temperatures

In high-temperature environments, the effects of dimensional changes caused by heat can become a problem. The High-Temperature LM Guide and High-Temperature Grease are used because they offer outstanding heat resistance and are subjected to minimal dimensional changes following heating and cooling.

### Heat resistance:

#### High-Temperature LM Guide

This LM Guide offers outstanding heat resistance and is subjected to only minimal dimensional changes following heating and cooling.

### Grease:

#### High-Temperature Grease

High-temperature grease is used because it causes only minor fluctuations in rolling resistance even during temperature changes from normal temperature to high temperatures.

## 7 Low Temperatures

Under low-temperature conditions, grease is used that results in minimal effects on plastic parts caused by low temperatures while also minimizing fluctuations in rust preventative countermeasures caused by temperature changes from normal to low temperatures as well as fluctuations in rolling resistance even at low temperatures.

### Effects of low temperatures on plastic parts:

#### Stainless Steel LM Guide

Stainless steel is used for the material of the end plates of the LM block (through which plastic balls circulate).

### Rust preventative countermeasures:

Surface treatment of the linear motion system results in enhanced rust preventative capabilities.

### Grease:

**THK** AFC Grease is used that exhibits only minor fluctuations in rolling resistance even at low temperatures.

## 8 Fine movement

Extremely short strokes can cause oil films to be depleted and ineffective lubrication eventually leading to rapid wear. In cases such as this, a grease is selected that has excellent oil film strength and enables the oil film to be formed easily.

### Grease:

#### **THK** AFC Grease

This urea-based grease offers excellent oil film strength and wear resistance.

# Special Environmental Specifications of Linear Motion Systems

## Clean Rooms

- Measures against dust generation
- Rust preventative countermeasures

### LM Guide with Caged Ball Technology

Applicable types **SHS** **SVR/SVS**  
**SSR** **SHW** **SRS**  
**SCR** **EPF**

### Caged Roller LM Guide

Applicable types **SRG** **SRN** **SRW**

### Stainless Steel LM Guide

Applicable types **HSR** **SR** **SSR**  
**HR** **RSR** **SHW**  
**HRW** **SRS**

### High Corrosion Resistance LM Guide

Applicable type **HSR-M2**

### Oil-Free LM Guide

Applicable type **SR-MS**

### Surface Treatment

### Grease

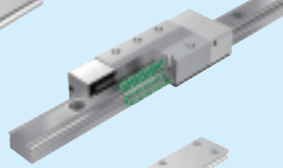
**SHS**



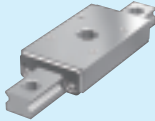
**SSR**



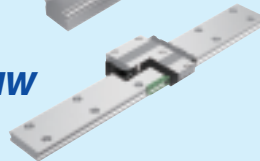
**SVR/SVS**



**EPF**



**SHW**



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**SRG**



**SRN**



**SRW**



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**HSR**



**SR**

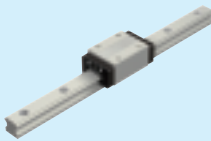


**RSR**



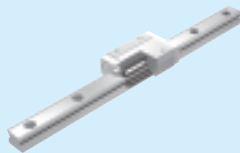
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**HSR-M2**



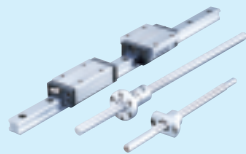
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**SR-MS**



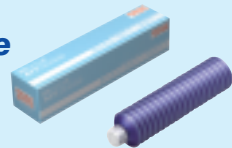
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**THK AP-HC Treatment**



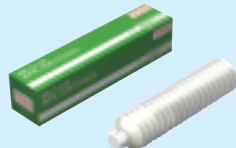
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**THK AFF Grease**



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**THK AFE-CA Grease**



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# Special Environmental Specifications of Linear Motion Systems

## Vacuum

- Measures against released gases
- Measures against grease splatter
- Rust preventative countermeasures
- Stainless Steel LM Guide

### High-Temperature LM Guide

Applicable types **HSR-M1** **RSR-M1**  
**SR-M1**

### LM Guide for Medium-to-Low Vacuum

Applicable type **HSR-M1VV**

### Oil-Free LM Guide

Applicable type **SR-MS**

### High Corrosion Resistance LM Guide

Applicable type **HSR-M2**

### Stainless Steel LM Guide

Applicable types **HSR** **SR** **HR**  
**RSR** **HRW**

### Vacuum Grease

## Oil-Free

- Dry Lubricant

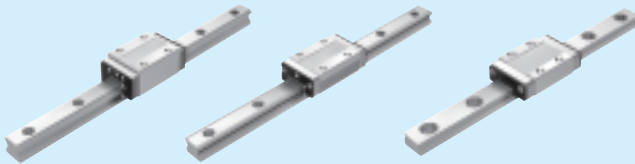
### Oil-Free LM Guide



**HSR-M1**

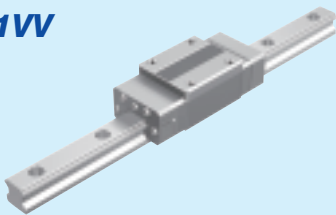
**SR-M1**

**RSR-M1**



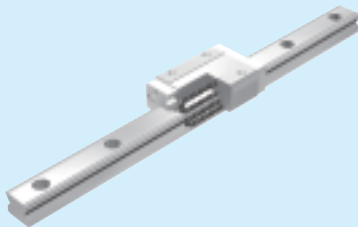
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**HSR-M1VV**



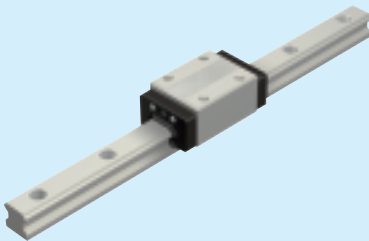
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**SR-MS**



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**HSR-M2**

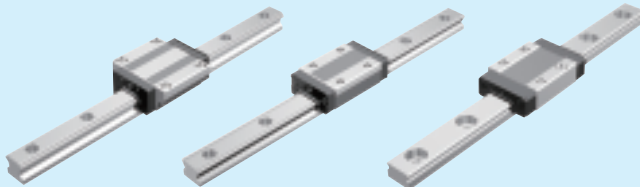


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**HSR**

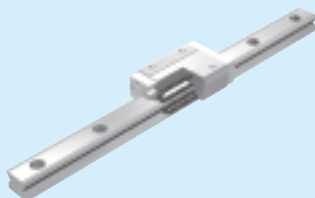
**SR**

**RSR**



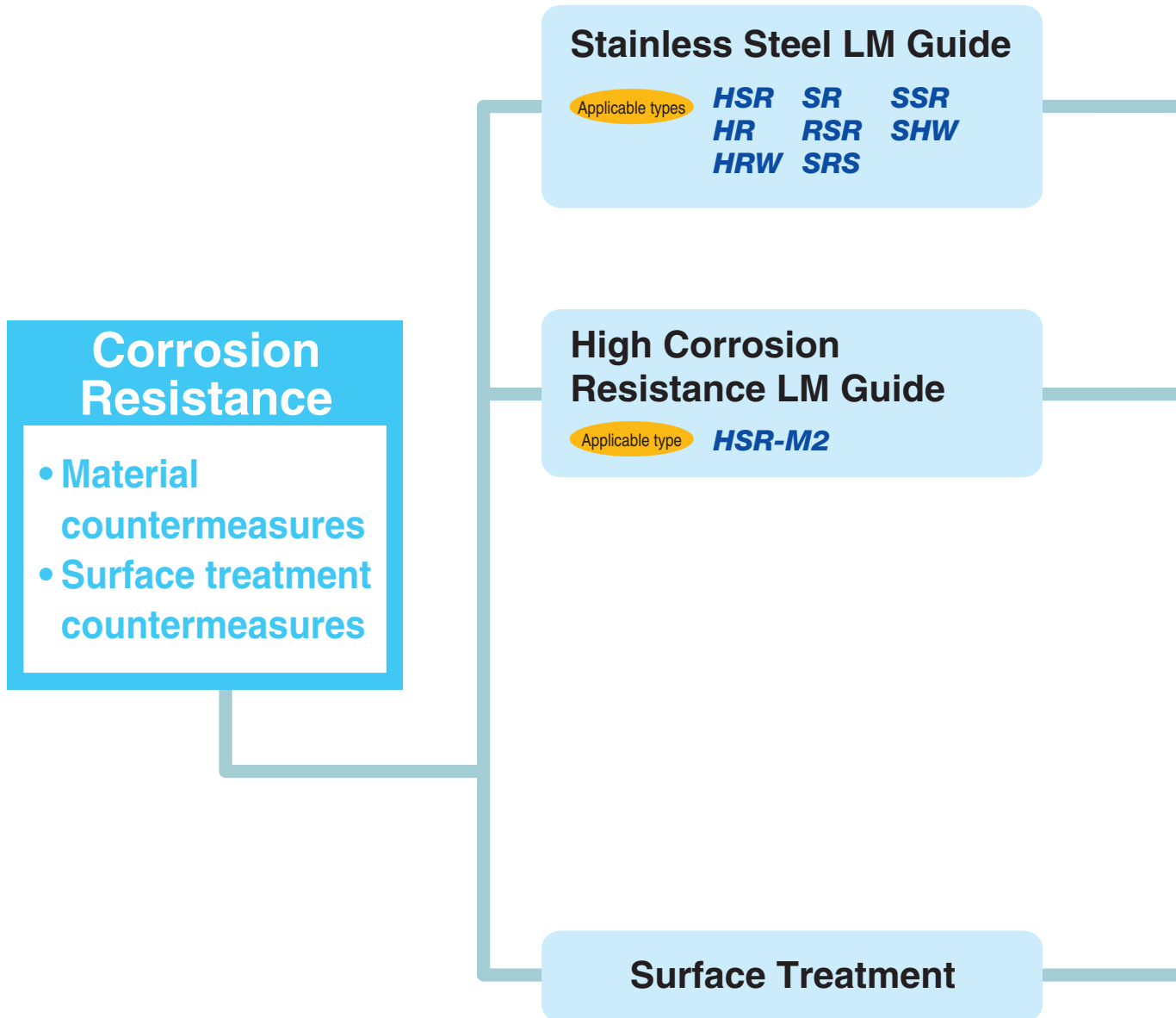
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**SR-MS**



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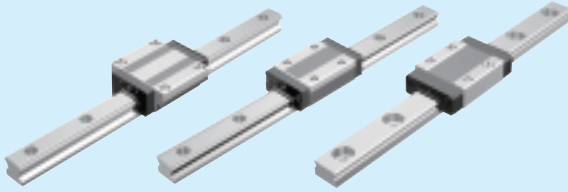
# Special Environmental Specifications of Linear Motion Systems



**HSR**

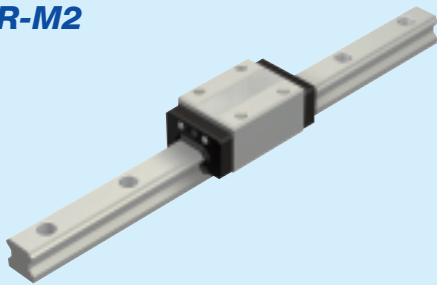
**SR**

**RSR**



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**HSR-M2**



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**THK AP-HC Treatment**



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**THK AP-C Treatment**



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**THK AP-CF Treatment**



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# Special Environmental Specifications of Linear Motion Systems

## High Speed

- Measures against heat generation
- Grease retention

### LM Guide with Caged Ball Technology

Applicable types

**SHS**  
**SSR**  
**SCR**

**SVR/SVS**  
**SHW** **SRS**  
**EPF**

### Caged Roller LM Guide

Applicable types

**SRG** **SRN** **SRW**

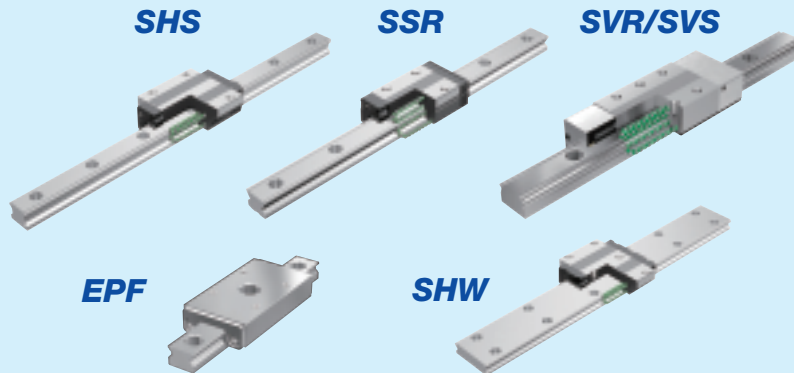
### High-Speed Ball Screw with Caged Ball Technology

Applicable types

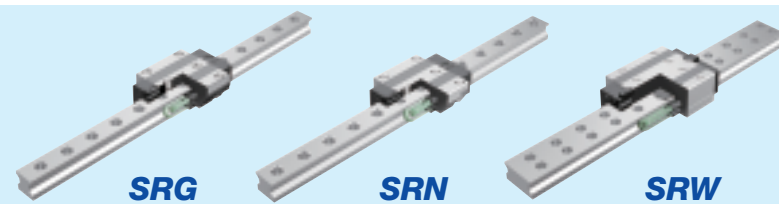
**SBK** **HBN** **SBN**  
**SDA** **SBKH**

### Lubricator QZ

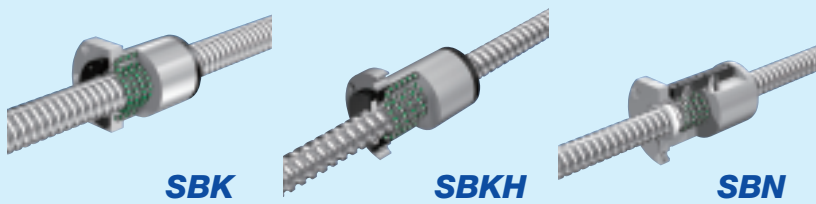
### Grease



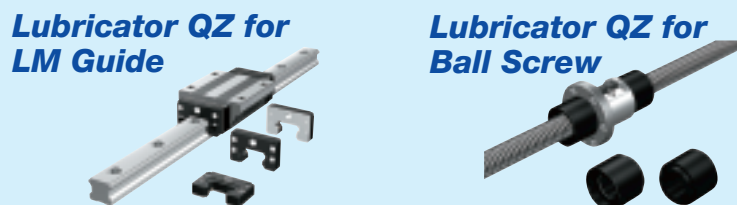
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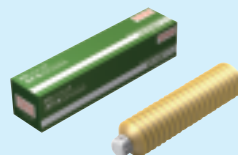
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For Ball Screw  
**THK AFG Grease**



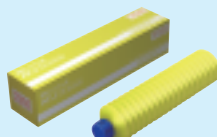
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**THK AFA Grease**



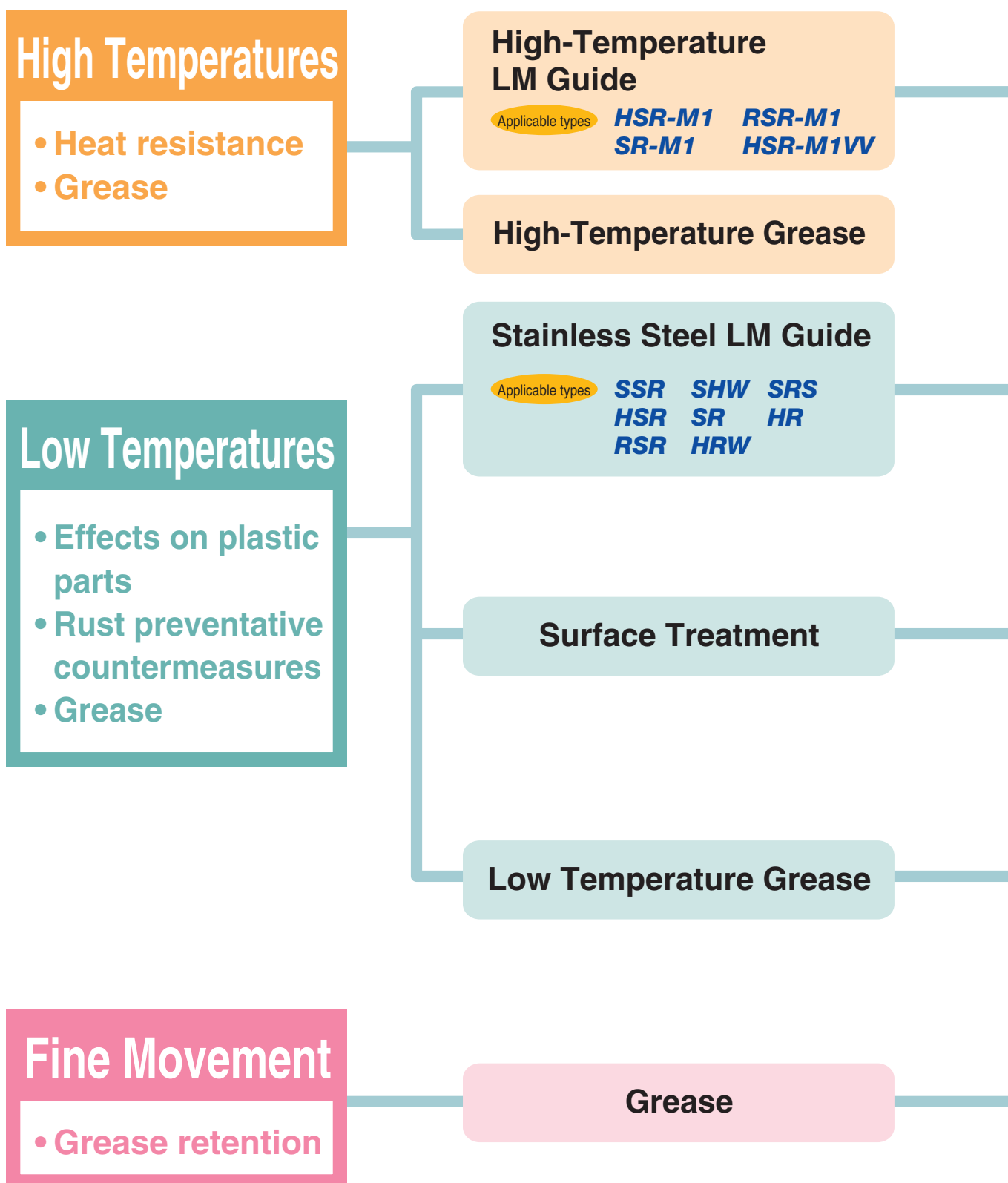
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**THK AFJ Grease**



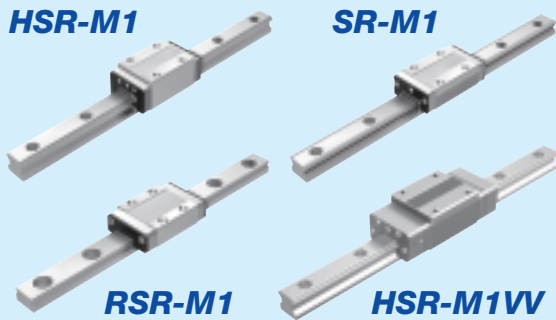
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# Special Environmental Specifications of Linear Motion Systems



**HSR-M1**

**SR-M1**



**RSR-M1**

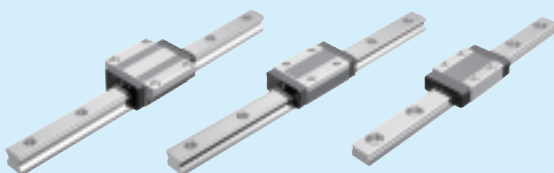
**HSR-M1VV**

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**HSR**

**SR**

**RSR**



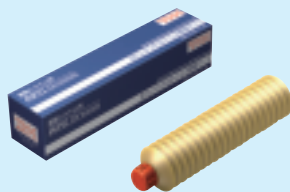
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**THK AP-CF Treatment**



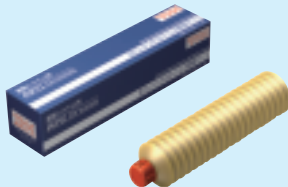
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**THK AFC Grease**



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**THK AFC Grease**



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# LM Guide with Caged Ball Technology

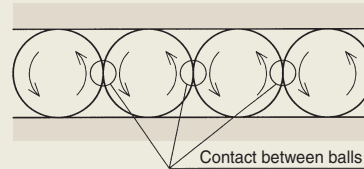
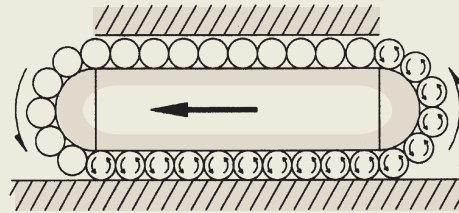
Clean  
Rooms

High  
Speed

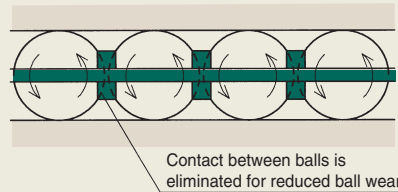
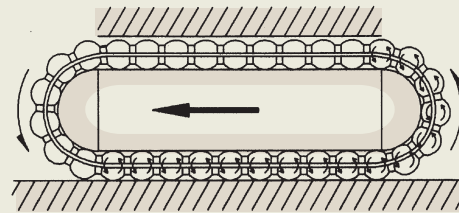
The LM Guide with Caged Ball is able to demonstrate outstanding low dust generation performance due to the low level of production of metal wear fragments as a result of the ball cage eliminating friction between the balls.

## Friction Between Balls

Conventional type  
(without ball cage)



New type  
(with ball cage)



Contact structure between balls and ball cage

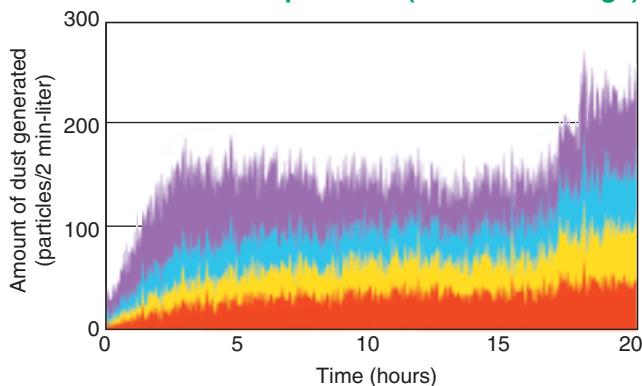
Ball cage



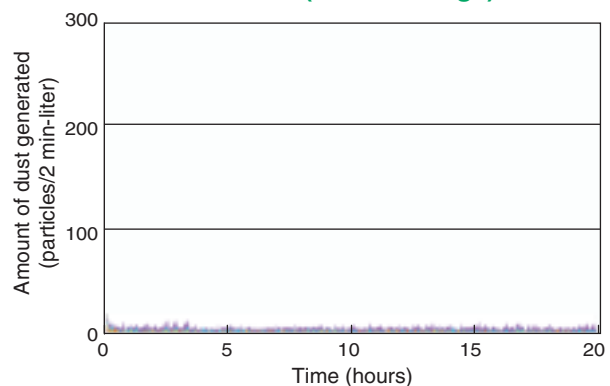
## Low Dust Generation Data

|                                    |           |           |
|------------------------------------|-----------|-----------|
| Particle size<br>( $\mu\text{m}$ ) | 0.3 – 0.5 | 2.0 – 5.0 |
|                                    | 0.5 – 1.0 | 5.0 –     |
|                                    | 1.0 – 2.0 |           |

Conventional products (without ball cage)

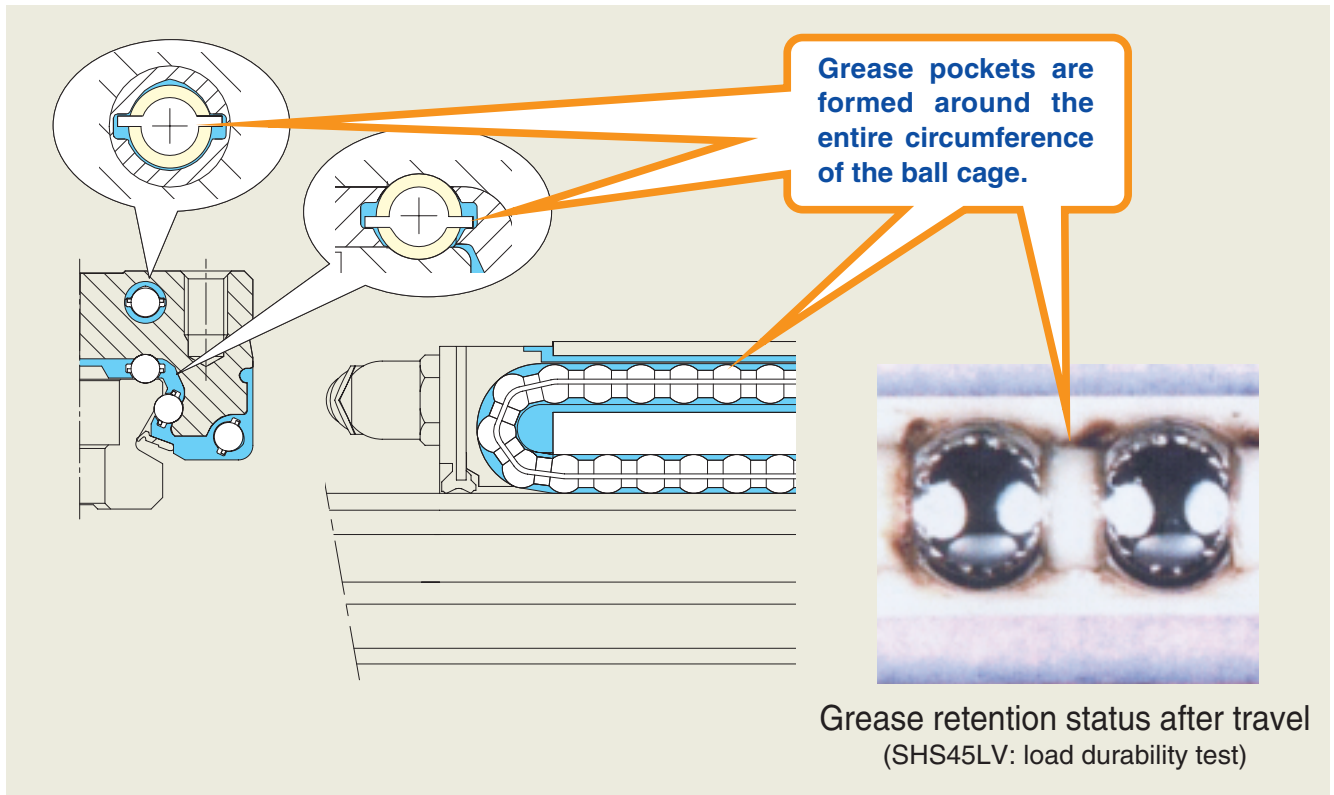


SSR20 (with ball cage)



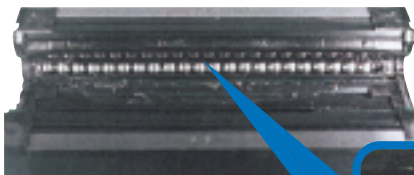
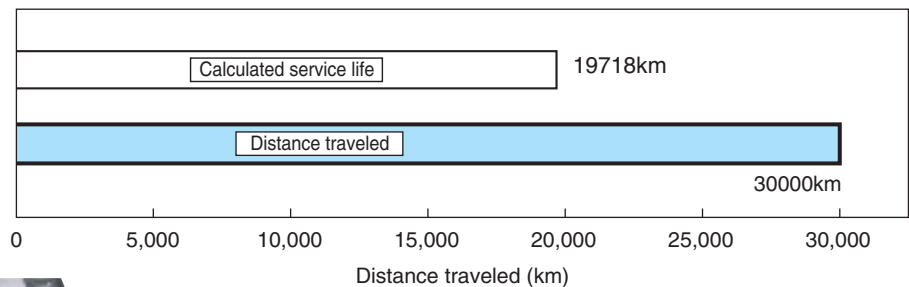


The use of ball cages reduces the generation of heat caused by friction between the balls, thereby improving grease retention capabilities and resulting in outstanding high-speed performance.



## ■ High-Speed Durability Test Results

Sample : SHS65LVSS  
 Speed : 200 m/min  
 Stroke : 2,500 mm  
 Lubrication : Initial sealing of grease only  
 Acting load : 34.5 kN  
 Acceleration : 1.5 G



Grease remains on the balls and there are no abnormalities observed in the balls or grease.

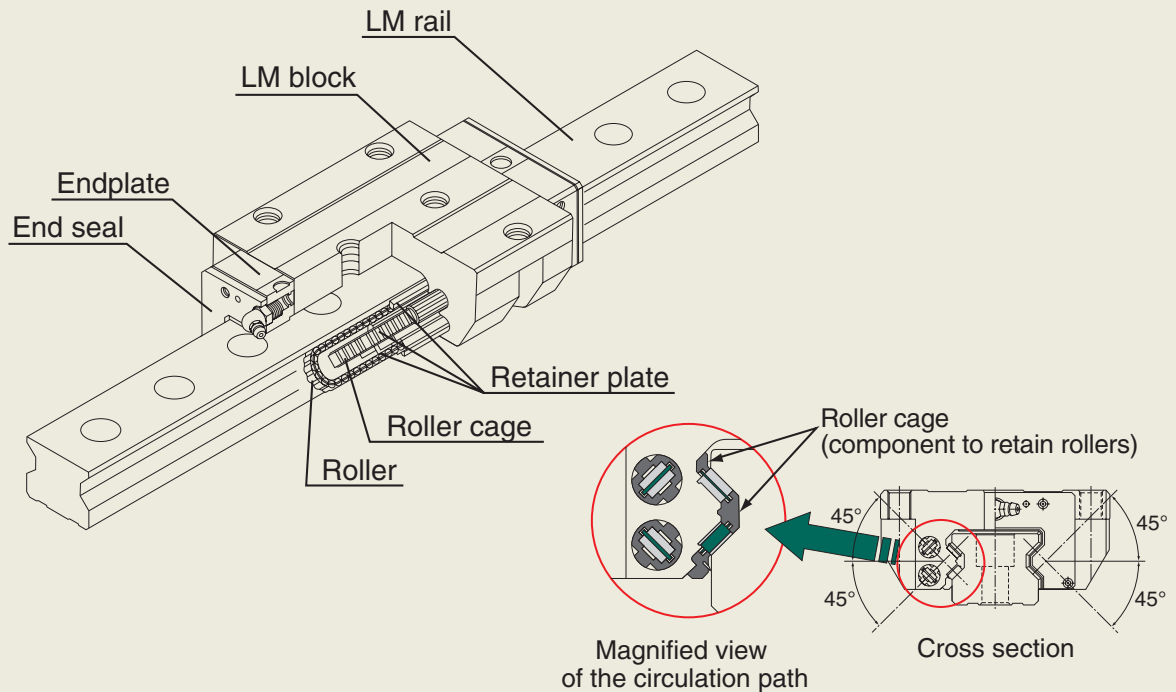
Detailed illustration of ball cage

# Caged Roller LM Guide

Clean  
Rooms

High  
Speed

Caged Roller LM Guide is a roller guide that achieves low-friction, smooth motion and long-term maintenance-free operation by using a roller cage. In addition, to ensure ultra-high rigidity, rollers with low elastic deformation are used as the rolling elements and the roller diameter and the roller length are optimized.



Structural Drawing of the Caged Roller LM Guide  
Model SRG

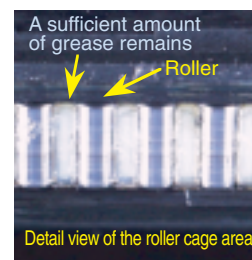
## High-speed Durability Test Data

### Conditions

|                      |  |
|----------------------|--|
| Model No.            | SRG45LC  |
| Magnitude of preload | clearance C0                                   |
| Speed                | 180m/min                                       |
| Acceleration         | 1.5G   |
| Stroke               | 2300mm   |
| Lubrication          | Initial lubrication only<br>(THKAFB-LF Grease) |

### Results

**No anomaly observed after running 15,000 km**



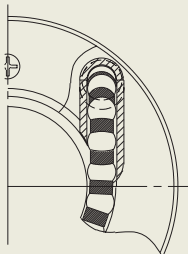
# High-Speed Ball Screw with Caged Ball Technology

High Speed

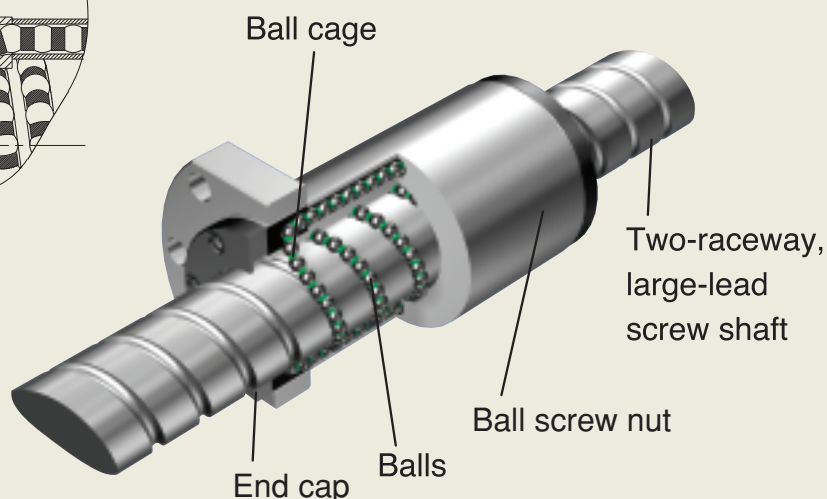
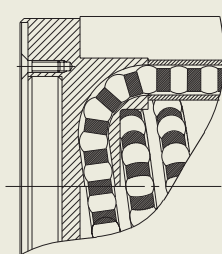
With High-Speed Ball Screw with Ball Cage model SBK, balls are evenly spaced by a ball cage to eliminate collision and friction between the balls and ensure a high level of grease retention. As a result, low noise, low torque fluctuation and long-term maintenance-free operation are achieved.

## Stress-free, ideal circulation structure

Balls circulate toward the tangential direction



Balls circulate toward the lead-angle direction



Structural Drawing of Model SBK

In addition, this model has an ideal circulation structure where balls are picked up in the tangential direction, thus to achieve a DN value\* of 160,000 (\* DN value = ball center diameter × rotation speed per minute) in high-speed operation.

### High-Speed Durability Test

#### Conditions

|                |  |
|----------------|--|
| Sample         | High Speed Ball Screw with Ball Cage SBN3210-7 |
| Speed          | 3900 (min <sup>-1</sup> ) (DN value: 130,000)  |
| Stroke         | 400 mm   |
| Lubricant      | THK AFG Grease                                 |
| Amount applied | 12 cm <sup>3</sup> (lubricated every 1000 km)  |
| Load           | 1.73 kN  |
| Acceleration   | 1 G  |

#### Results

Shows no deviation after running 10,000 km

### Load Durability Test

#### Conditions

|                |  |
|----------------|--|
| Sample         | High Speed Ball Screw with Ball Cage SBN3210-7 |
| Speed          | 1500 (min <sup>-1</sup> ) (DN value: 50,000)   |
| Stroke         | 300 mm   |
| Lubricant      | THK AFG Grease                                 |
| Amount applied | 12 cm <sup>3</sup>                             |
| Load           | 17.3 kN(0.5Ca)                                 |
| Acceleration   | 0.5 G  |

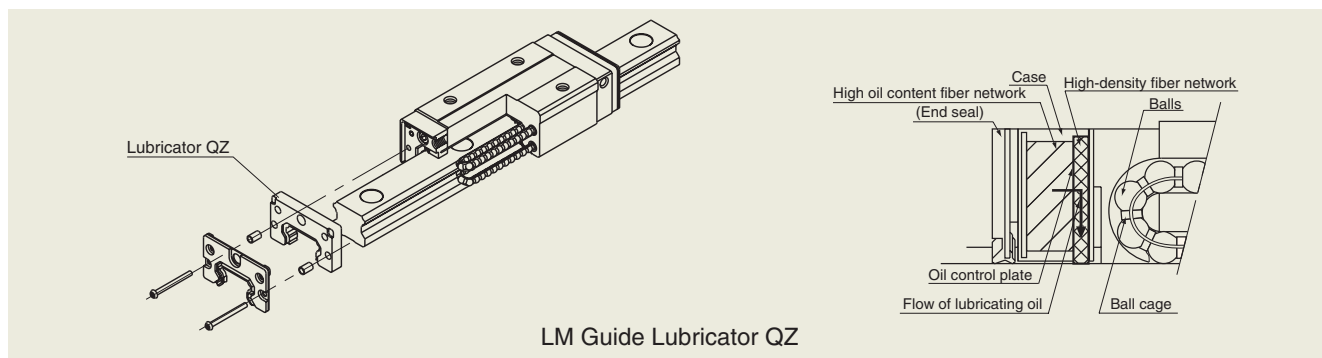
#### Results

Shows no deviation after running a distance 2.5 times the calculated service life

# Lubricator QZ

High Speed

The LM Guide and Ball Screw lose a small amount of grease during the course of travel. The Lubricator QZ is a revolutionary new lubrication system that supplies an appropriate amount of lubricating oil at the appropriate locations, thereby enabling it to compensate for any oil lost over a long period of time. Installation of the Lubricator QZ on the LM Guide with Ball Cage or High-Speed Ball Screw with Ball Cage, demonstrating excellent grease retention capabilities, results in even further enhanced lubrication performance.



Since the Lubricator QZ supplies an optimal amount of lubricating oil at appropriate locations, lubricating oil can be used without waste.

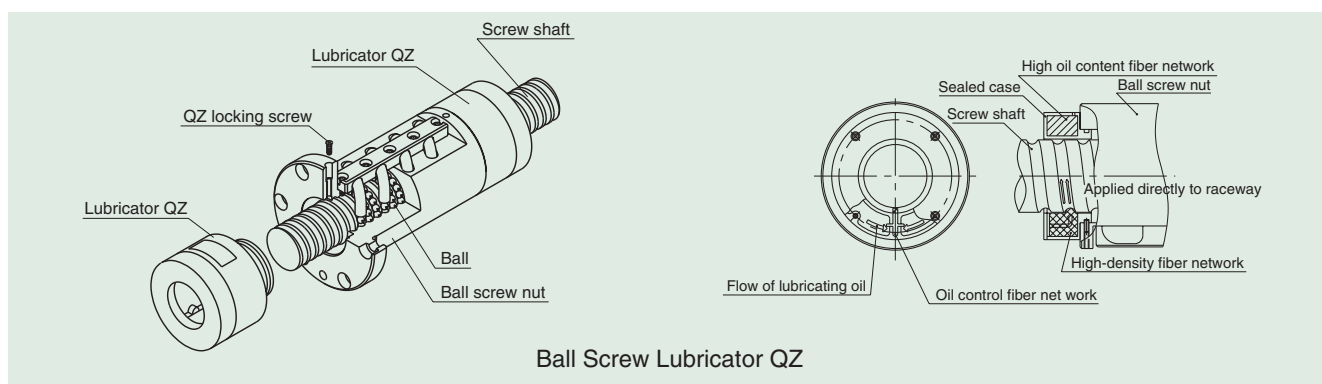
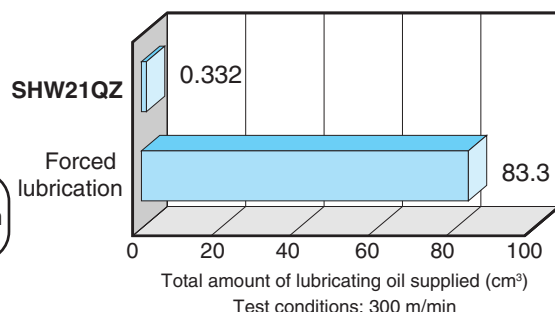
## Comparison of Amount of Lubricating Oil Used After Travelling 5,000 km

Lubricator QZ oil content:  
 $0.166 \text{ cm}^3/\text{sheet} \times 2 \text{ sheets}$   
 $= 0.332 \text{ cm}^3$

Comparison

Forced lubrication:  
 $0.03 \text{ cm}^3/6 \text{ min} \times 16667 \text{ min}$   
 $= 83.3 \text{ cm}^3$

Amount of lubricating oil used is 1/250 that of forced lubrication.



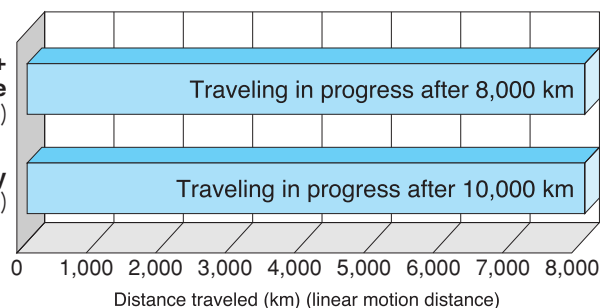
## Significant Extension of Maintenance Intervals

Since lubricating oil continues to be supplied for a long time, maintenance intervals can be extended considerably.

|                  |                         |
|------------------|-------------------------|
| Rotational speed | 2500m/min <sup>-1</sup> |
| Max. speed       | 25m/min <sup>-1</sup>   |
| Stroke           | 500 mm                  |
| Load             | Internal preload only   |

**QZ + AFG grease**  
 (Model No.:SBN3210)

**QZ only**  
 (Model No.:BIF2510)



# Stainless Steel LM Guide

Clean Rooms

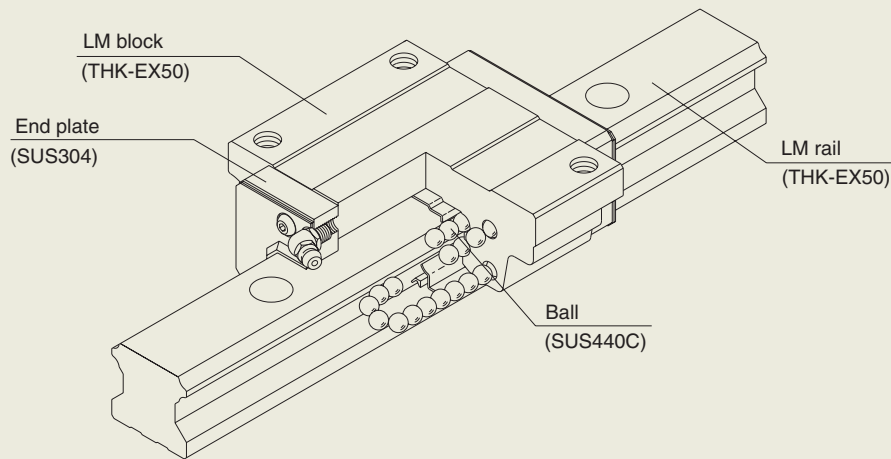
Vacuum

Corrosion Resistance

Low Temperatures

Stainless Steel LM Guide delivers outstanding corrosion resistance as a result of using martensite stainless steel. In addition, heat treatment to a level of HRC58 or higher results in a long service life, enabling it to withstand high loads.

Although plastic end plates are used in ordinary environments, when used in a vacuum environment, SUS304 (austenite stainless steel) is used for the end plates to reduce the level of released gases. SUS304 materials are characterized by low oxidation and low levels of released gases.



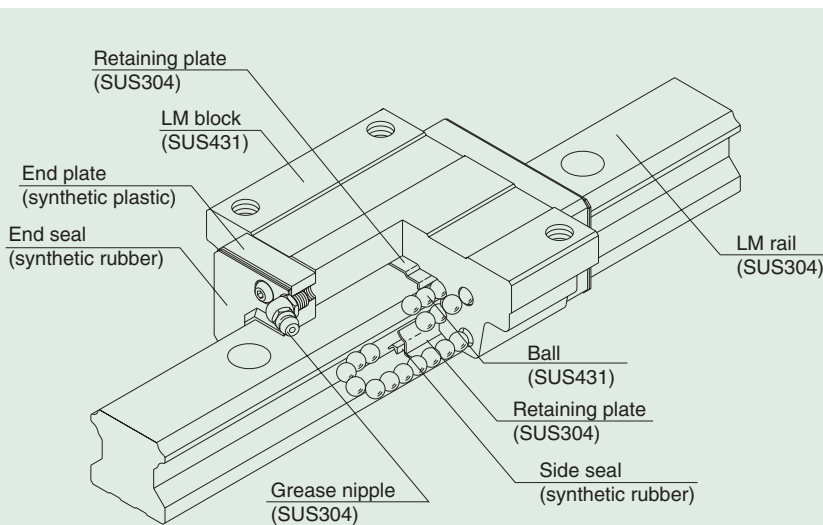
# High Corrosion Resistance LM Guide

Clean Rooms

Vacuum

Corrosion Resistance

Austenite stainless steel SUS304, offering excellent corrosion resistance, is used for the LM rail, while SUS431, offering the highest level of corrosion resistance among martensite stainless steel materials, is used for the LM block and balls. The result is a significant improvement in corrosion resistance over conventional stainless steel.

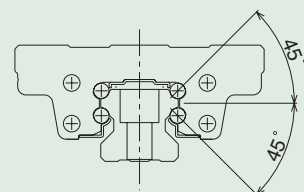
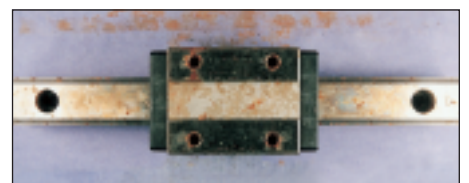


Structure of the Type HSR-M2A High Corrosion Resistance LM Guide

## High Corrosion Resistance LM Guide



## Stainless Steel Guide



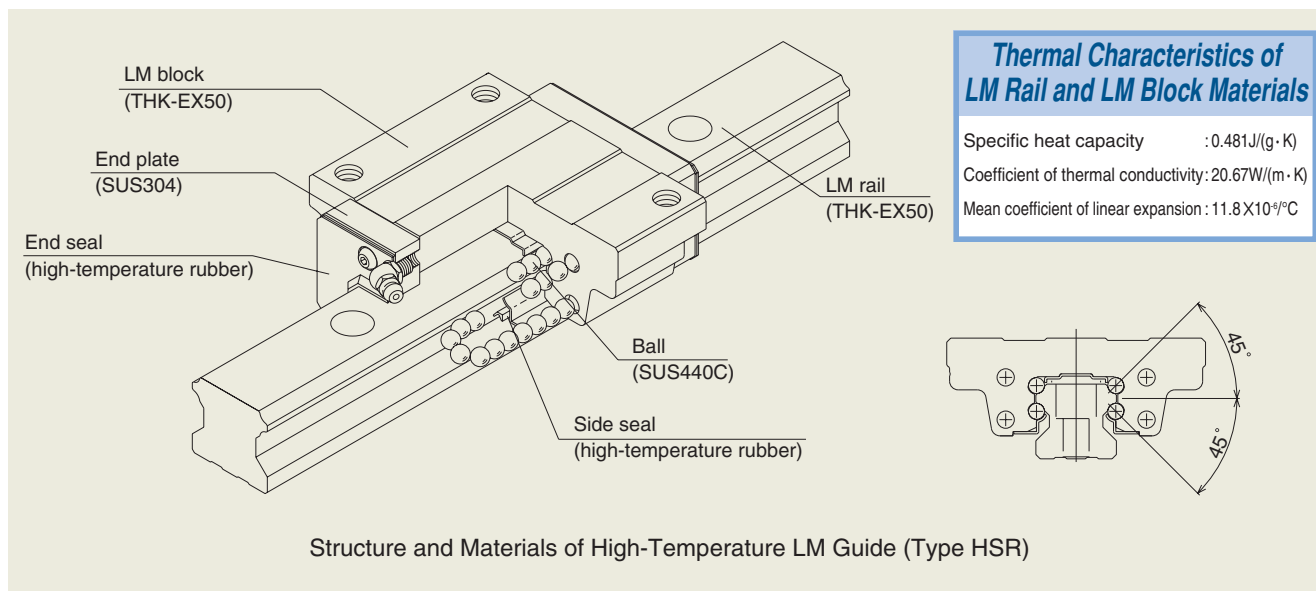
# High-Temperature LM Guide

Vacuum

High Temperatures

The LM block and LM rail are made of **THK**-EX50 martensite stainless steel additionally treated for dimensional stability to minimize the effects of heat on dimensional changes.

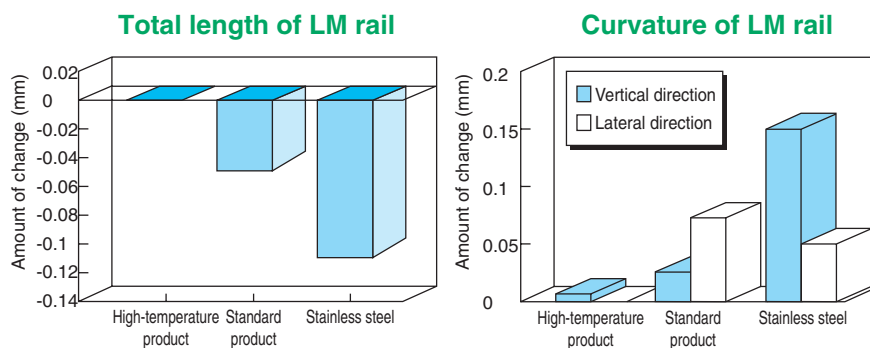
SUS304 austenite stainless steel is used for the end plates for enhanced heat resistance.



## Dimensional Stability Data

Dimension stabilization treatment makes it possible to reduce dimensional changes following heating and cooling to extremely low levels.

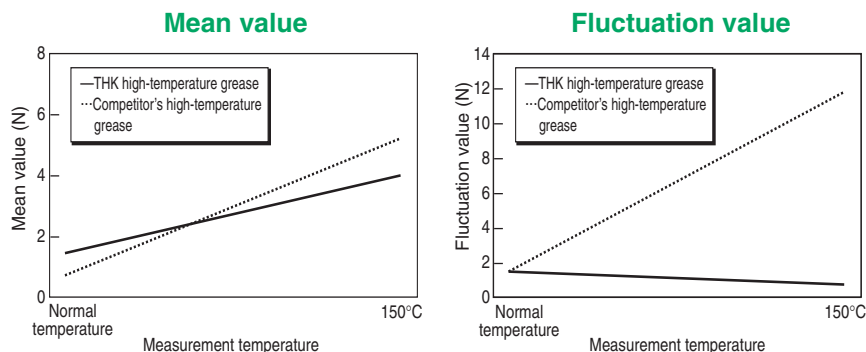
- Total length and curvature data indicate the amount of change when from normal temperature to 150°C for 100 hours followed by cooling to normal temperature.
- HSR25 + 580L high-temperature, standard and stainless steel products were used for the samples.



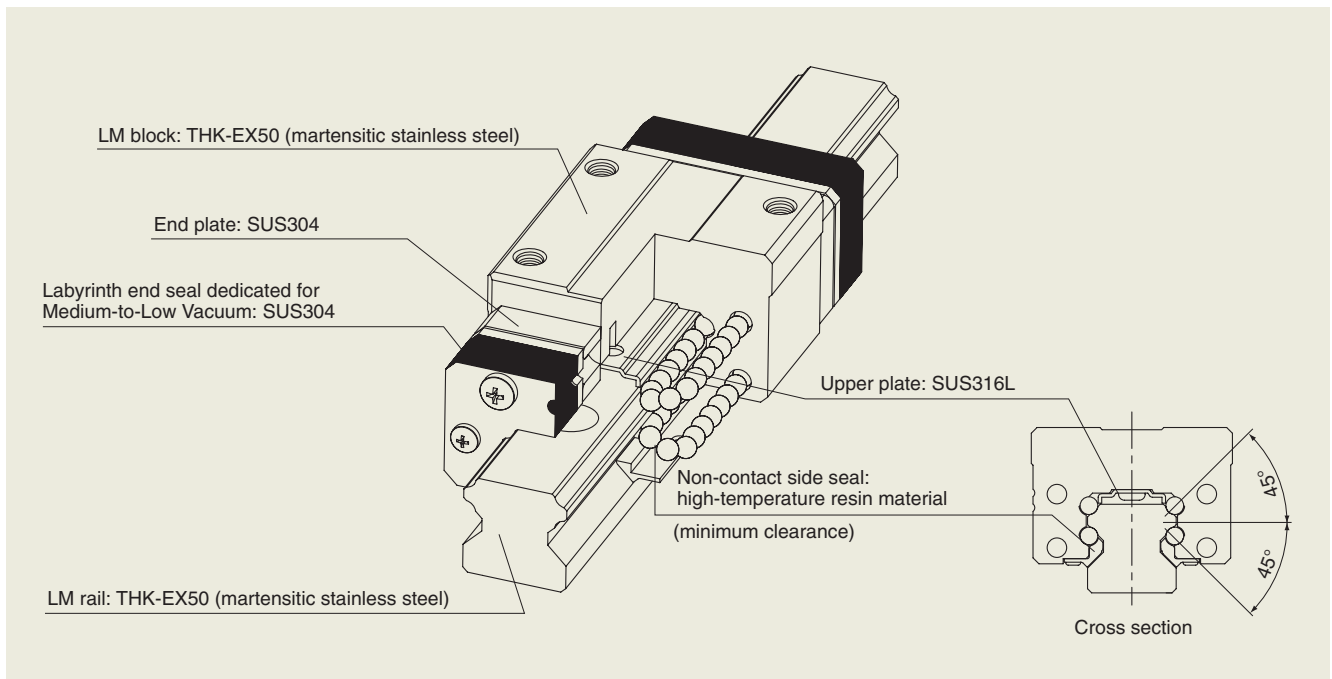
## Grease-Induced Rolling Resistance Data

High-temperature grease is used that minimizes changes and fluctuations (catching) in rolling resistance caused by the grease even when the temperature changes from normal temperature to high temperature.

HSR25M1R1C1 is used as the sample for the above data.







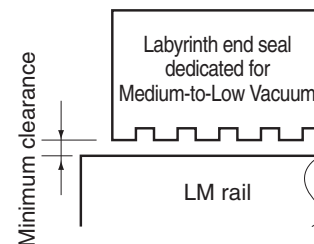
- (1) Operable in various environments at pressure between atmospheric pressure and vacuum ( $10^{-3}$  [Pa]).
- (2) Capable of withstanding baking temperature up to 200°C \*.
- (3) Use of a newly developed labyrinth end seal dedicated for Medium-to-Low Vacuum increases grease retention and allows extended use in vacuum.
- (4) Use of grease designed for Medium-to-Low Vacuum achieves a stable rolling resistance.

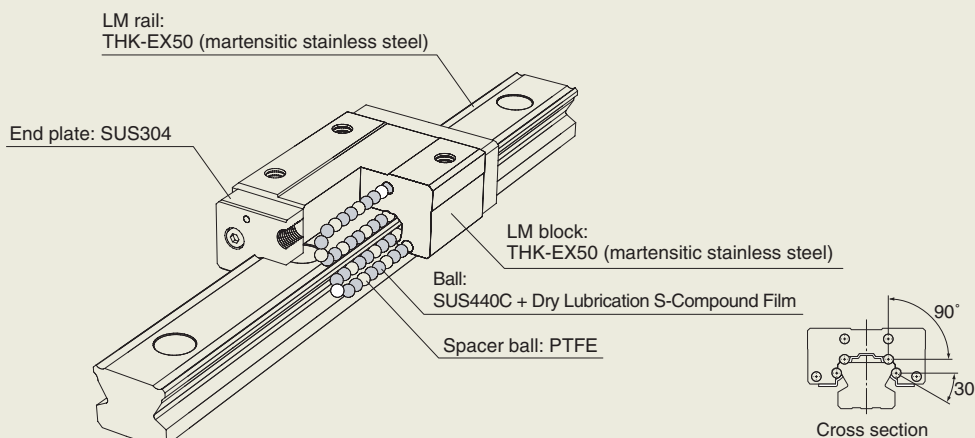
\* If the baking temperature exceeds 100°C, multiply the basic load rating with the temperature coefficient.

## ■ Structure of the labyrinth end seal dedicated for Medium-to-Low Vacuum

The labyrinth end seal dedicated for Medium-to-Low Vacuum forms a multi-stage space as shown in the figure on the right to minimize the pressure difference between adjacent stages.

This reduces the outflow velocity of the oil inside the LM block to a minimum. In addition, the seal will not affect the rolling resistance since it does not contact the LM rail.





## 1. Uses stainless steel

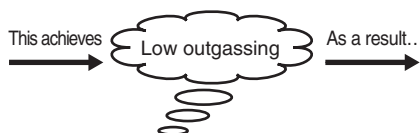
All components are composed of parts for special environments such as stainless steel.

## 2. Degreased and cleaned

Special solvent is used to de-grease this model.

## 3. Does not use grease

Use of highly reliable dry lubricant S-compound film for stainless steel balls achieves grease-free lubrication.



## Greatest advantage

Suitable for applications where the vacuum level reaches  $10^{-6}$  Pa and chemical contamination (gaseous contamination such as organic matter and moisture) is not allowed.

\* Can be used at temperature up to 150°C (instantaneously 200°C).

## What is Dry Lubrication S-Compound Film

Dry Lubrication S-Compound Film is a fully dry lubricant developed for use under atmospheric to highvacuum environments.

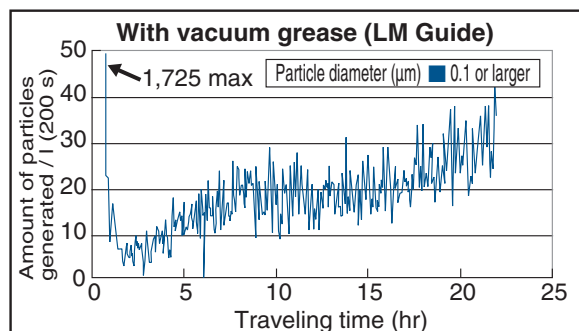
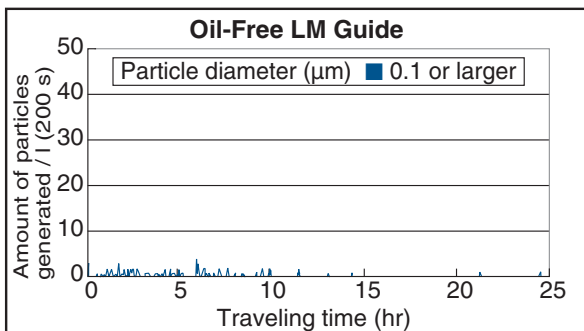
It has superior characteristics in load carrying capacity, wear resistance and sealability to other lubrication systems.

Comparison of dry lubrication material properties

| Item                                  | Friction coefficient (reference value) | Wear resistance | Hardness | Service environment          |
|---------------------------------------|--|-----------------|----------|------------------------------|
| Molybdenum Disulfide (hexagonal form) | 0.04                                   | △               | △        | Vacuum                       |
| Soft metal                            | 0.05~0.5                               | △               | △        | Atmosphere, vacuum           |
| DLC (diamond like carbon)             | 0.08~0.15                              | △               | ○        | Atmosphere, H <sub>2</sub> O |
| Dry Lubrication S-Compound Film       | 0.02~0.05                              | ○               | ○        | Atmosphere, vacuum           |

## Low Dust Generation

The Oil-Free LM Guide for special environments exerts a lower level of dust generation than conventional vacuum grease lubricants.





# Surface Treatment

Clean  
Rooms

Corrosion  
Resistance

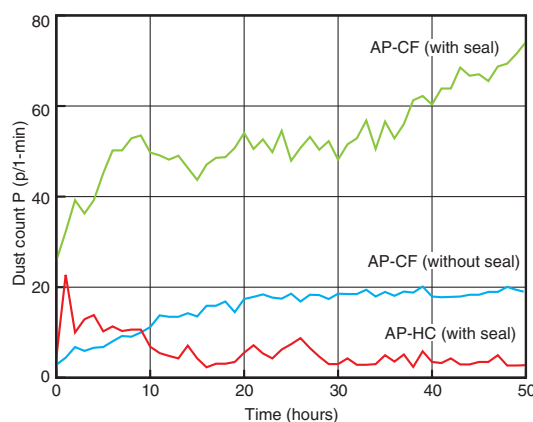
Low  
Temperatures

## THK AP-HC Treatment

THK AP-HC treatment is equivalent to hard chrome plating, and allows for corrosion resistance nearly equivalent to that of martensite stainless steel.

In addition, since surface treatment is performed that results in the formation of a film having a hardness of 750 HV or more, dust generation is reduced while offering outstanding wear resistance.

### Characteristics of THK AP-HC Treatment



#### Test Conditions

LM guide model numbers :

SSR20WF + 280LF (AP-CF without seal)

SSR20UUF + 280LF (AP-CF with seal)

SSR20UUF + 280LF (AP-HC with seal)

Injected grease : THK AFE-CA Grease

Amount applied : 1 cc (1LM block)

Speed : 30 m/min (max)

Stroke : 200 mm

Measurement flow rate : 1 liter/min

Clean room volume : 1.7 liters (acrylic case)

Measuring instrument : Dust counter

Measured particle size : 0.3  $\mu$ m and above

THK AP-HC treatment results in high surface hardness and offers excellent wear resistance. The large amount of wear occurring in the initial portion of the graph is considered to be attributed to initial wear of the end seals.

Note: THK AP-HC treatment (equivalent to hard chrome plating)

THK AP-CF treatment (equivalent to black chrome plating + fluororesin coating)

## THK AP-C Treatment

THK AP-C treatment consists of black film treatment for the purpose of improving corrosion resistance. It is used in applications requiring rust prevention since it is priced lower than stainless steel LM guides.

## THK AP-CF Treatment

THK AP-CF treatment consists of compound surface treatment in which a special fluororesin is coated into a black film. Since this treatment results in complete coverage of metal surfaces, it offers a high degree of rust prevention and is suitable in cases requiring a high level of corrosion resistance. Moreover, since the fluororesin constitutes a chemically stable film, it also offers outstanding contamination resistance.

| Surface treatment | Rust prevention capabilities | Wear resistance | Surface hardness | Sealing | Appearance     |
|-------------------|------------------------------|-----------------|------------------|---------|----------------|
| AP-HC             | ○                            | ◎               | ◎                | ◎       | Metallic gloss |
| AP-C              | ◎                            | △               | △                | △       | Black gloss    |
| AP-CF             | ◎                            | ○               | △                | ○       | Black gloss    |

◎ (Superior)

#### Cycled saltwater spraying test

Sprayed solution : 1% NaCl solution

Cycle : Spraying for 6 hours followed by drying for 6 hours

Temperature conditions : During spraying : 35°C

During drying : 60°C

| Test material  | Austenite stainless steel | Martensite stainless steel | THK AP-HC | THK AP-C | THK AP-CF |
|----------------|---------------------------|----------------------------|-----------|----------|-----------|
| Before testing |                           |                            |           |          |           |
| After 6 hours  |                           |                            |           |          |           |
| After 24 hours |                           |                            |           |          |           |
| After 96 hours |                           |                            |           |          |           |

**THK** AFF Grease uses a high-grade synthetic oil, lithium-based consistency enhancer and a special additive. It achieves stable rolling resistance, low dust generation and high fretting resistance, at a level that conventional vacuum greases or low dust generation greases have not reached.

## [ Features ]

### (1) Stable rolling resistance

Since the viscous resistance is low, the rolling resistance fluctuation is also low. Thus, superb conformity is achieved at low speed.

### (2) Low dust generation

AFF Grease generates little dust, making itself an ideal grease for use in clean rooms.

### (3) Fretting resistance

Since AFF Grease is more resistant to wear from microvibrations than other low particle generative grease, it allows the greasing interval to be extended.

## Typical Properties of AFF Grease

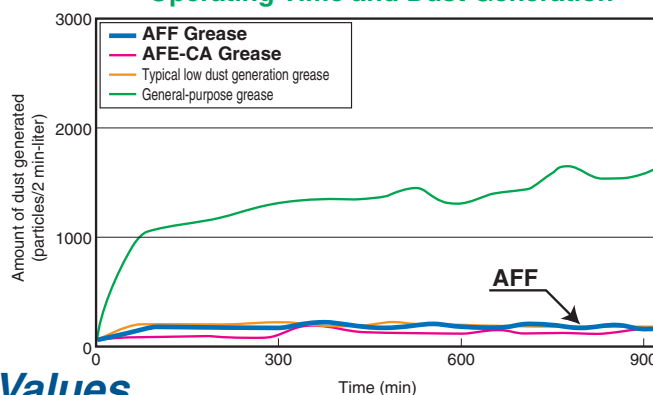
| Test item  | Representative value       | Test method   |
|--|----------------------------|---------------|
| Consistency enhancer                                     | Lithium-based              | —             |
| Base oil   | high-grade synthetic oil   | —             |
| Base oil kinematic viscosity: mm <sup>2</sup> /s (40 °C) | 100                        | JIS K 2220 23 |
| Worked penetration (25°C, 60W)                           | 315                        | JIS K 2220 7  |
| Mixing stability (100,000 W)                             | 345                        | JIS K 2220 15 |
| Dropping point °C  | 220                        | JIS K 2220 8  |
| Evaporation amount: mass% (99°C, 22h)                    | 0.7                        | JIS K 2220 10 |
| Oil separation rate: mass% (100°C, 24h)                  | 2.6                        | JIS K 2220 11 |
| Copper plate corrosion (B method, 100°C, 24h)            | Accepted                   | JIS K 2220 9  |
| Low temperature torque: N·m (-20°C)                      | Start (revolutions) 220 60 | JIS K 2220 18 |
| 4-ball testing (burn-in load): N                         | 1236                       | ASTM D2596    |
| Service Temperature Range °C                             | - 40 to 120                | —             |
| Color  | Red-dish brown             | —             |

## Low Dust Generation Characteristics

### Test Conditions

| Item                      | Description  |
|---------------------------|--|
| Model used                | SR20W1 + 280LP   |
| Amount of grease injected | 1 cm <sup>3</sup> /1 LM block (initial injection only) |
| Air supply volume         | 500 cm <sup>3</sup> /min                               |
| Measuring instrument      | Particle counter                                       |
| Measured particle size    | 0.3 μm and above                                       |
| Speed                     | 30 m/min   |
| Stroke                    | 200 mm   |

### Operating Time and Dust Generation



## Stable Rolling Resistance Values

### Test Conditions

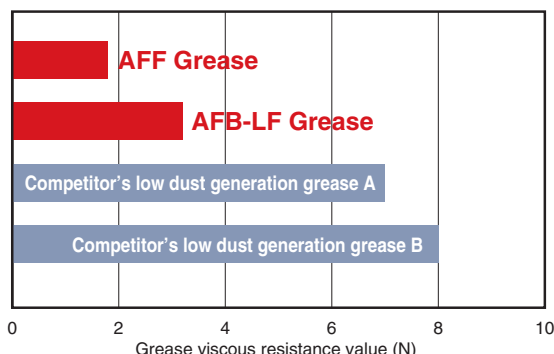
| Item                      | Description  |
|---------------------------|--|
| Model used                | HSR25A1C1 + 580LP                                      |
| Amount of grease injected | 3 cm <sup>3</sup> /1 LM block (initial injection only) |
| Speed                     | 10 mm/s  |

(23°C)

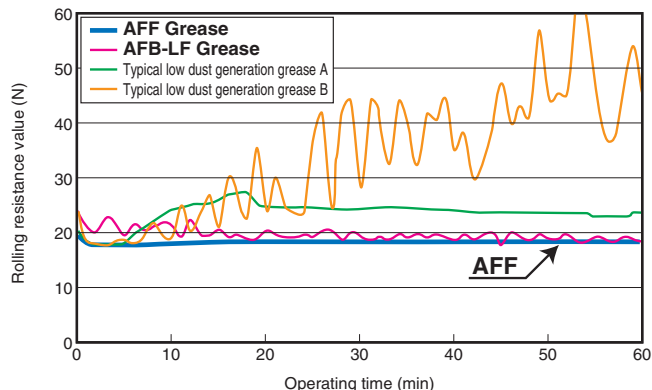
### Test Conditions

| Item                      | Description  |
|---------------------------|--|
| Model used                | HSR35RC0 + 440LP                                       |
| Amount of grease injected | 4 cm <sup>3</sup> /1 LM block (initial injection only) |
| Speed                     | 1 mm/s   |
| Stroke                    | 3 mm   |

### Grease Viscous Resistance Values



### Low-Speed Rolling Resistance Values



**THK** AFE-CA Grease uses urea as a consistency enhancer and a high-grade synthetic oil as the base oil. It has low dust generative characteristics and is therefore a suitable grease for clean room environments.

## [ Features ]

### (1) Low dust generation

Compared with vacuum greases in conventional use, AFE-CA Grease generates less dust and therefore is ideal for use in clean rooms.

### (2) Long service life

Unlike ordinary soap based grease for metal lubrication, AFE-CA Grease excels in anti-oxidation stability and therefore can be used for a long period of time. As a result, maintenance work is reduced.

## Typical Properties of AFE-CA Grease

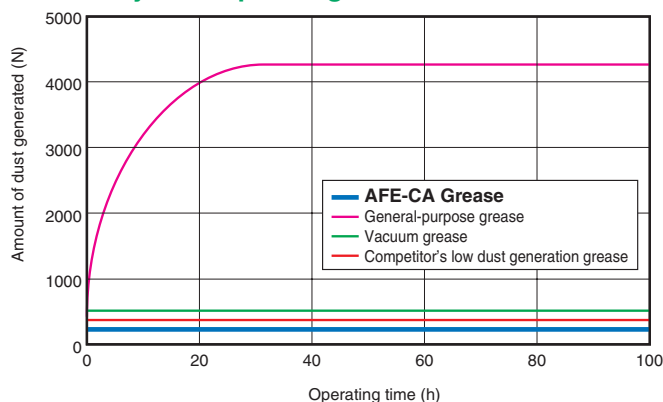
| Test item   | Representative value          | Test method   |
|---|-------------------------------|---------------|
| Consistency enhancer                                    | Urea-based                    | —             |
| Base oil  | high-grade synthetic oil      | —             |
| Base oil kinematic viscosity: mm <sup>2</sup> /s (40°C) | 99                            | JIS K 2220 23 |
| Worked penetration (25°C, 60W)                          | 280                           | JIS K 2220 7  |
| Mixing stability (100,000 W)                            | 310                           | JIS K 2220 15 |
| Dropping point °C                                       | 260                           | JIS K 2220 8  |
| Evaporation amount: mass% (99°C, 22h)                   | 0.1                           | JIS K 2220 10 |
| Oil separation rate: mass% (100°C, 24h)                 | 0.1                           | JIS K 2220 11 |
| Copper plate corrosion (B method, 100°C, 24h)           | Accepted                      | JIS K 2220 9  |
| Low temperature torque: N·m (-20°C)                     | Start 130<br>(revolutions) 76 | JIS K 2220 18 |
| 4-ball testing (burn-in load): N                        | 1236                          | ASTM D2596    |
| Service Temperature Range °C                            | -40 to 180                    | —             |
| Color   | Light yellowish brown         | —             |

## Low Dust Generation Characteristics

### Test Conditions

| Item                      | Description                |
|---------------------------|----------------------------|
| Model used                | Type KR4610                |
| Ball screw rotating speed | 1000min <sup>-1</sup>      |
| Stroke                    | 210mm                      |
| Amount of grease injected | Ball screw, LM guide: 2 cc |
| Measurement flow rate     | 1 l/min                    |
| Measuring instrument      | Dust counter               |
| Particle size             | 0.5 μm                     |

### LM System Operating Time and Dust Generation



## Long Service Life Characteristics

### Surface Status of Balls After Traveling

Magnification: 200×

### Test Conditions

| Item                      | Conditions                            |
|---------------------------|---------------------------------------|
| Model used                | HSR25A                                |
| Speed                     | 30m/min                               |
| Loaded                    | 4.9kN                                 |
| Amount of grease injected | 1 cc/raceway (initial injection only) |

| Distance traveled                  | 290km                             | 440km                             |
|------------------------------------|-----------------------------------|-----------------------------------|
| Name                               |                                   |                                   |
| THK AFE-CA Grease                  | Hardly any color change or damage | Hardly any color change or damage |
| Typical low dust generation grease |                                   |                                   |

**THK** AFG Grease is a high-grade grease for Ball Screws that uses a high-grade synthetic oil as the base oil and a urea-based consistency enhancer. It excels in low heat generation and supports a wide temperature range from low to high temperature.

## [ Features ]

### (1) Low heat generation

Since the viscous resistance is low, the grease generates only a minimal level of heat even during high-speed operation.

### (2) Low viscosity

Since the viscosity is low, a stable rotational torque is achieved.

### (3) Wide temperature range

Maintains a high level of lubricity in a wide temperature range of -45 °C to +160 °C.

### (4) Long service life

AFG Grease is not easily softened and excels in antioxidation stability even after a long-term operation.

### (5) Water resistance

AFG Grease is a highly water resistant grease that is less vulnerable to moisture penetration and little decreases resistance to extreme pressure.

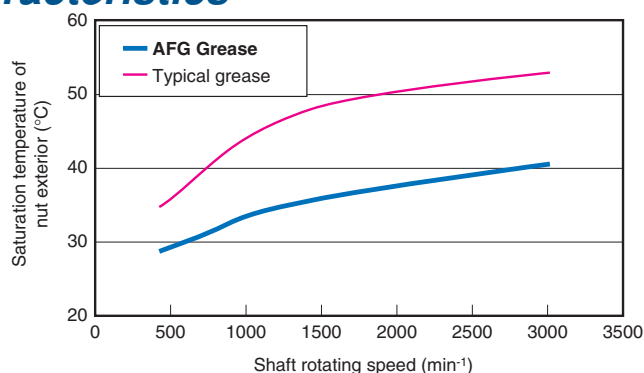
## Typical Properties of AFG Grease

| Test item   | Representative value          | Test method   |
|---|-------------------------------|---------------|
| Consistency enhancer                                    | Urea-based                    | —             |
| Base oil  | high-grade synthetic oil      | —             |
| Base oil kinematic viscosity: mm <sup>2</sup> /s (40°C) | 25                            | JIS K 2220 23 |
| Worked penetration (25°C, 60W)                          | 285                           | JIS K 2220 7  |
| Mixing stability (100,000 W)                            | 329                           | JIS K 2220 15 |
| Dropping point °C                                       | 261                           | JIS K 2220 8  |
| Evaporation amount: mass% (99°C, 22h)                   | 0.2                           | JIS K 2220 10 |
| Oil separation rate: mass% (100°C, 24h)                 | 0.5                           | JIS K 2220 11 |
| Copper plate corrosion (B method, 100°C, 24h)           | Accepted                      | JIS K 2220 9  |
| Low temperature torque: N·m (-20°C)                     | Start 170<br>(revolutions) 70 | JIS K 2220 18 |
| 4-ball testing (burn-in load): N                        | 3089                          | ASTM D2596    |
| Service Temperature Range °C                            | - 45 to 160                   | —             |
| Color   | Brown                         | —             |

## Low Heat Generation Characteristics

### Test Conditions

| Item                             | Description                 |
|----------------------------------|-----------------------------|
| Shaft diameter/lead              | 32/10mm                     |
| Speed                            | 67 - 500mm/s                |
| Shaft rotating speed             | 400 - 3000min <sup>-1</sup> |
| Stroke                           | 400mm                       |
| Amount of grease injected        | 12cm <sup>3</sup>           |
| Temperature measurement location | Nut exterior                |



## Ball Screw High-Speed Durability Test

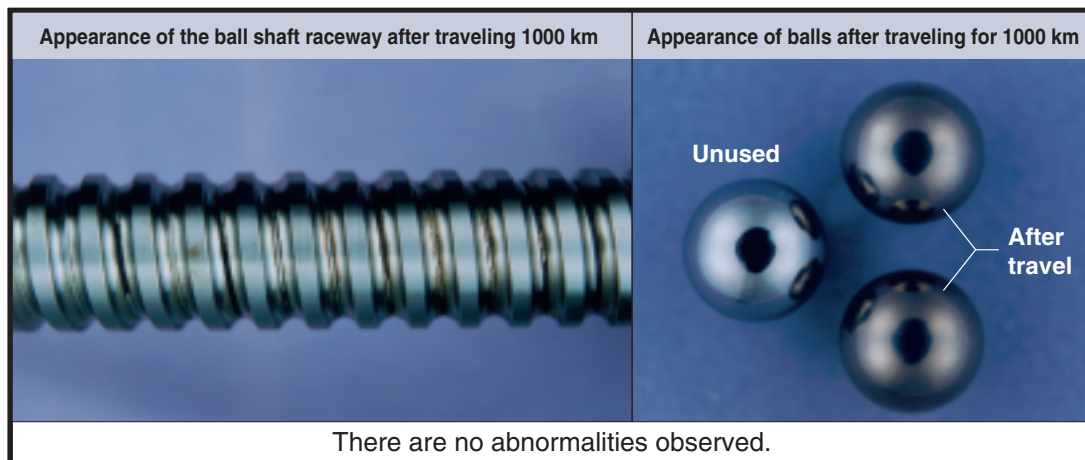
Combining with a ball screw with ball cage enabled use at ultra-high speeds at a DN value of 130,000.

### Test Conditions

| Item                | Description                                |
|---------------------|--|
| Shaft diameter/lead | 32/10mm                                    |
| Max. rotating speed | 3900 min <sup>-1</sup> (DN value: 130,000) |
| Stroke              | 400 mm                                     |
| Acceleration        | 9.8 m/s <sup>2</sup>                       |

### [Lubrication Conditions]

Lubricant : **THK** AFG Grease  
Injection volume : 12 cm<sup>3</sup>  
(initial injection only)



**THK** AFA Grease is a high-grade, long-life grease developed with a urea-based consistency enhancer using a high-grade synthetic oil as the base oil.

## [ Features ]

### (1) Long service life

Unlike ordinary soap based grease for metal lubrication, AFA Grease excels in antioxidation stability and therefore can be used for a long period of time.

### (2) Wide temperature range

The lubricating performance remains high over a wide range of temperatures from -45 °C to +160°C.

Even at low temperatures, AFA Grease requires only a low starting torque.

### (3) High water resistance

AFA Grease is less vulnerable to moisture penetration than other types of grease because of its high water resistance.

### (4) High mechanical stability

AFA Grease is not easily softened and demonstrates excellent mechanical stability even when used for a long period of time.

## Typical Properties of AFA Grease

| Test item   | Representative value     | Test method   |
|---|--------------------------|---------------|
| Consistency enhancer                                    | Urea-based               | —             |
| Base oil  | high-grade synthetic oil | —             |
| Base oil kinematic viscosity: mm <sup>2</sup> /s (40°C) | 25                       | JIS K 2220 23 |
| Worked penetration (25°C, 60W)                          | 285                      | JIS K 2220 7  |
| Mixing stability (100,000 W)                            | 329                      | JIS K 2220 15 |
| Dropping point °C                                       | 261                      | JIS K 2220 8  |
| Evaporation amount: mass% (99°C, 22h)                   | 0.2                      | JIS K 2220 10 |
| Oil separation rate: mass% (100°C, 24h)                 | 0.5                      | JIS K 2220 11 |
| Copper plate corrosion (B method, 100°C, 24h)           | Accepted                 | JIS K 2220 9  |
| Low temperature torque: N-m (-20°C)                     | Start (revolutions)      | JIS K 2220 18 |
|   | 170 (70)                 |               |
| 4-ball testing (burn-in load): N                        | 3089                     | ASTM D2596    |
| Service Temperature Range °C                            | - 45 to 160              | —             |
| Color   | Brown                    | —             |

## ■ Rotation Torque Testing with Ball Screw Grease

<Test method>

Apply 1 cc of grease to the LM Guide of KR4620A+640L and 2 cc to the Ball Screw (initial lubrication only), and then measure the torque at each motor rotation speed.

In torque measurement, output values on the driver torque monitor are used.

## Comparative Table of Rotation Torque of Ball Screws by Grease

Unit: N-cm

| Grease                   | Central value of dynamic viscosity CST (mm <sup>2</sup> /s)(40°C) | Dynamic viscosity range CST (mm <sup>2</sup> /s)(40°C) | Rotational speed     |                       |                       |                       |
|--------------------------|---|--|----------------------|-----------------------|-----------------------|-----------------------|
|                          |   |  | 100min <sup>-1</sup> | 1000min <sup>-1</sup> | 2000min <sup>-1</sup> | 4000min <sup>-1</sup> |
| AFA Grease               | 25  | 22.5 to 27.5   | 11.27                | 11.27                 | 12.25                 | 14.6                  |
| Grease of manufacturer I | 130   | 117 to 143   | 14.6                 | 23.13                 | 31.16                 | 43.12                 |
| Grease of manufacturer K | 15.3  | 13.8 to 16.8   | 12.64                | 12.05                 | 13.03                 | 14.41                 |
| Lubricant VG32           | 32  | 28.8 to 35.2   | 11.17                | 10.78                 | 13.43                 | 14.7                  |

Note) The values of the competitors' greases are that of low-torque greases.



**THK** AFJ grease uses refined mineral oil as its base and contains urea-based consistency enhancer and other special additives that give excellent lubrication properties at a wide range of speeds, from low to high.

## [ Features ]

- (1) Wide range of speeds  
Provides consistent and even lubrication at both high and low work speeds.
- (2) Wear Resistance  
Even at low speeds, it has excellent oil film formation characteristics to reduce wear.
- (3) Resistant to vibration  
Reduces wear caused by machine vibration during high-speed operation.
- (4) Low rolling resistance  
Reduces rolling resistance in LM guides and ball screws over a wide range of speeds.

## Typical Properties of AFJ Grease

| Test item   | Representative value           | Test method   |
|---|--------------------------------|---------------|
| Consistency enhancer                                    | Urea-based                     | —             |
| Base oil  | refined mineral oil            | —             |
| Base oil kinematic viscosity: mm <sup>2</sup> /s (40°C) | 20                             | JIS K 2220 23 |
| Worked penetration (25°C, 60W)                          | 325                            | JIS K 2220 7  |
| Mixing stability (100,000 W)                            | 360                            | JIS K 2220 15 |
| Dropping point °C                                       | 185                            | JIS K 2220 8  |
| Evaporation amount: mass% (99°C, 22h)                   | 0.6                            | JIS K 2220 10 |
| Oil separation rate: mass% (100°C, 24h)                 | 7.0                            | JIS K 2220 11 |
| Copper plate corrosion (B method, 100°C, 24h)           | Accepted                       | JIS K 2220 9  |
| Low temperature torque: N·m (-20°C)                     | Start 380<br>(revolutions) 130 | JIS K 2220 18 |
| 4-ball testing (burn-in load): N                        | 3089                           | ASTM D2596    |
| Service Temperature Range °C                            | -20 to 120                     | —             |
| Color   | Yellowish brown                | —             |

## ■ Test data for LM guide block wear resistance

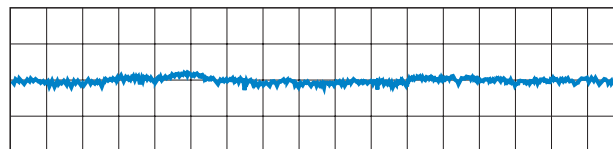
- AFJ grease test data (comparing the amount of wear)

The test data in the figure compares the test results for the amount of wear for this product and other greases.

### Test conditions

| Item            | Description                               |
|-----------------|---|
| Model No.       | NRS55B2SS+780LP                           |
| Applied load    | 5.9kN                                     |
| Feeding speed   | 0.1m/min                                  |
| Stroke          | 200mm                                     |
| Grease quantity | 12cm/ LM block (initial lubrication only) |
| Test duration   | 480 hours                                 |

### THK AFJ Grease



### Other urea-based grease



**THK** AFC Grease has high fretting-corrosion resistance due to a special additive and a urea-based consistency enhancer using a high-grade synthetic oil as the base oil.

## [ Features ]

- (1) High fretting-corrosion resistance  
AFC Grease is designed to be highly effective in preventing fretting corrosion.
- (2) Long service life  
Unlike ordinary soap based grease for metal lubrication, AFC Grease excels in antioxidation stability and therefore can be used for a long period of time. As a result, maintenance work is reduced.
- (3) Wide temperature range  
Since a high-grade synthetic oil is used as the base oil, the lubricating performance remains high over a wide range of temperatures from -54°C to +177°C.

## Typical Properties of AFC Grease

| Test item   | Representative value     | Test method   |
|---|--------------------------|---------------|
| Consistency enhancer                                    | Urea-based               | —             |
| Base oil  | high-grade synthetic oil | —             |
| Base oil kinematic viscosity: mm <sup>2</sup> /s (40°C) | 25                       | JIS K 2220 23 |
| Worked penetration(25°C, 60W)                           | 288                      | JIS K 2220 7  |
| Mixing stability (100,000 W)                            | 341                      | JIS K 2220 15 |
| Dropping point °C                                       | 269                      | JIS K 2220 8  |
| Evaporation amount:mass% (99°C, 22h)                    | 0.2                      | JIS K 2220 10 |
| Oil separation rate: mass% (100°C, 24h)                 | 0.6                      | JIS K 2220 11 |
| Copper plate corrosion(B method, 100°C, 24h)            | Accepted                 | JIS K 2220 9  |
| Low temperature torque: N-m (-20°C)                     | Start                    | JIS K 2220 18 |
|   | (revolutions)            |               |
| 4-ball testing (burn-in load): N                        | 3089                     | ASTM D2596    |
| Service Temperature Range °C                            | - 54 to 177              | —             |
| Color   | Brown                    | —             |

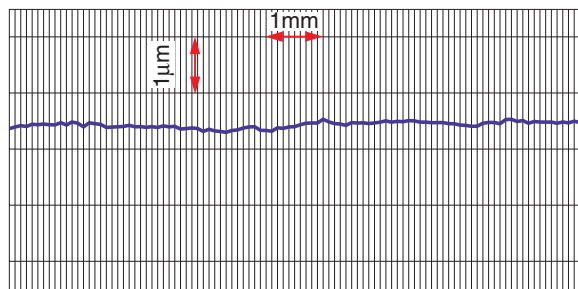
## ■ Test Data on Fretting-corrosion Resistance

### Test Conditions

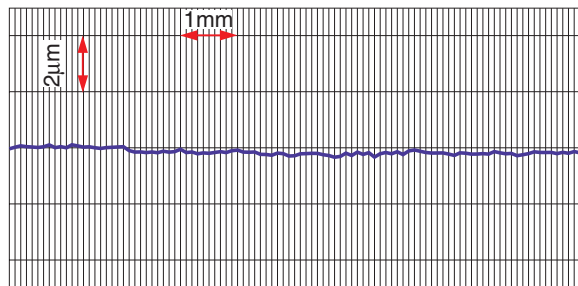
| Item                      | Description                        |
|---------------------------|------------------------------------|
| Stroke                    | 3 mm                               |
| Strokes/min               | 200 min <sup>-1</sup>              |
| Total strokes             | 2.88 × 10 <sup>5</sup> (24 hours)  |
| Bearing pressure          | 1118MPa                            |
| Amount of grease injected | 12 g/unit (supplied every 8 hours) |

### AFC Grease

Before travel

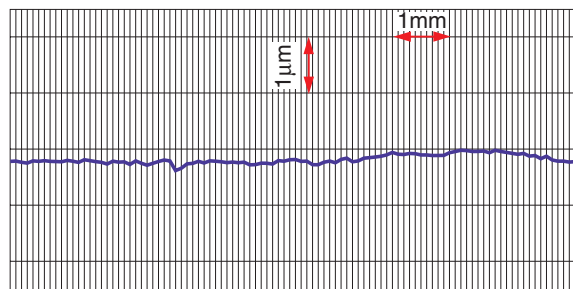


After travel

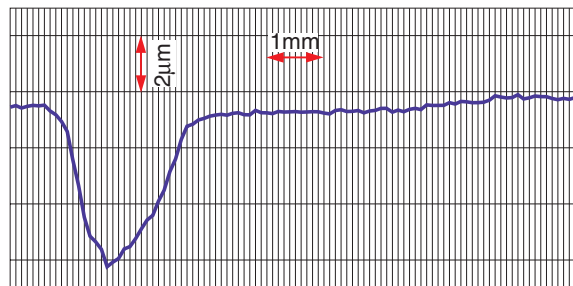


### General-purpose grease

Before travel



After travel



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