General Description

THK General Catalog

B Support Book

Selection Flowchart

1. Determining the operating conditions

- Dimensions of machines and systems
- Space in the guide section
- Mounting orientation (horizontal, vertical, slant mount, wall mount, suspended)
- Magnitude and direction of the working load
- Stroke length
- Speed
- Operating frequency (duty cycle)
- Required service life
- Kinetic frequency
- Environment

2. Selecting a type

- Select a type that suits the operating conditions

LM Guide	LM stroke
Miniature guide	Cross-roller guide
Slide pack	Linear stage
Ball spline	Roller type
Linear bushing	etc.

Selecting a drive method

- Feed screw (ball screw, trapezoidal threads)
- Cylinder
- Belt ● Wire ● Chain
- Rack and pinion ● Linear motor

3. Predicting the service life

- Select size
- Select the number of blocks/nuts
- Determine the number of rails/shafts

4. Rigidity

- Select clearance
- Select preload
- Determine the securing method
- Determine the rigidity of the mounting section

5. Accuracy

- Select an accuracy grade (feeding accuracy, runout accuracy)
- Determine the accuracy of the mounting surface

6. Lubricating and protecting an LM System

- Determine lubricant (grease, oil, special lubricant)
- Determine lubrication method (periodic lubrication, forced lubrication)
- Determine material (standard material, stainless steel, high-temperature material)
- Determine surface treatment (anti-rust, appearance)
- Design contamination protection (bellows, telescopic cover, etc.)

7. Calculating the thrust force

- Obtain the thrust force required for linear motion

Selection completed

LM System Types and Features

Type	LM Guide	Ball spline	Linear bushing
Appearance			
Features	• Ideal structure with four raceways, circular-arc grooves, and two-point contact • Superb error-absorbing capability with DF design • Averages accuracy by absorbing mounting surface error • Large permissible load and high rigidity • Low friction coefficient	• Large torque load capacity • Optimal for torque-transmitting mechanisms and locations where torque and radial load are simultaneously applied • No angular backlash • Ball retention	• Interchangeability • LM System capable of performing infinite linear motion at a low price
Stroke	Infinite stroke	Infinite stroke	Infinite stroke
Major applications	• Surface grinders • Electric discharge machines • High-speed transfer equipment • NC lathes • Injection molding machines • Woodworking machines • Semiconductor manufacturing equipment • Inspection equipment • Food-related machines • Medical equipment	• Assembly robot Z axes • Automatic loaders • Transfer machines • Automatic conveyance systems • Wire winders • Grinding machine spindle drive shafts • Construction vehicle steering mechanisms • Blood test equipment • Automatic tool changers • Golf training machines	• Measuring instruments • Digital 3D measuring instruments • Printing machines • OA equipment • Vending machines • Medical equipment • Food packaging machines
Introduced on page	B1-1 and on	B3-1 and on	B4-1 and on

Type	LM stroke	Precision linear pack	Cross-roller guide
Appearance			
Features	• Capable of performing rotary motion, straight motion, and complex motion • Capable of performing rolling motion with an extremely small friction coefficient • Low cost	• Ultra-thin and lightweight • Reduced design and assembly costs	• Long service life and high rigidity • Easy clearance adjustment
Stroke	Finite stroke	Infinite stroke	Finite stroke
Major applications	• Press die settings • Printing machine ink roll units • Optical measuring instruments • Spindles • Solenoid valve guides • Press post guides • Load cells • Photocopiers • Inspection machines	• Magnetic disc devices • Electronic equipment • Semiconductor manufacturing equipment • Medical equipment • Measuring equipment • Plotting machines • Photocopiers	• Measuring instruments • Component mounters • Printed circuit board drilling machines • Inspection equipment • Small stages • Handling mechanisms • Automatic lathes • Tool grinders • Internal grinding machines • Small surface grinding machines
Introduced on page	B **5-1** and on	B **6-1** and on	B **7-1** and on

Type	Cross-roller table	Linear ball slide	LM roller
Appearance			
Features	• Easily installable unit • Choose from several modes of use	• Easily installable unit • Lightweight and compact • Capable of performing compact rolling motion with an extremely small friction coefficient • Low cost	• Compact with large load capacity • Automatic skewing adjustment
Stroke	Finite stroke	Finite stroke	Infinite stroke
Major applications	• Measuring equipment stages • Optical stages • Tool grinders • Printed circuit board drilling machines • Medical equipment • Automatic lathes • Internal grinding machines • Small surface grinding machines	• Small electronic part assembly machines • Handlers • Automatic recorders • Measuring equipment stages • Optical stages • Medical equipment	• Precision press ram guides • Press mold exchangers • Heavy load conveyor systems • Bending machines
Introduced on page	B8-1 and on	B9-1 and on	B10-1 and on

Type	Flat roller	Slide pack	Slide rail
Appearance			
Features	• Large load capacity • Combined accuracy of a 90° V-shaped surface and a flat surface available as standard	• Interchangeable • Low-cost and simple	• Thin and compact design • Low-cost and simple • High strength and high durability
Stroke	Infinite stroke	Infinite stroke	Finite stroke
Major applications	• Planers • Horizontal milling machines • Roll grinding machines • Surface grinders • Cylindrical grinders • Optical measuring instruments	• Amusement machines • High-grade furniture • Light and heavy doors • Tool cabinets • Kitchen equipment • Automatic feeders • Computer peripherals • Photocopiers • Medical equipment • Office equipment	• Amusement machines • High-grade furniture • Light and heavy doors • Office equipment • Store fixtures • Stockers
Introduced on page	B11-1 and on	B12-1 and on	B13-1 and on

Load Rating

Service Life of an LM System

When an LM System rolls under a load, its raceway and rolling elements (balls or rollers) constantly receive repetitive stress. After reaching a certain limit, the raceway fractures from fatigue and part of the surface flakes like scales. This phenomenon is called flaking.
The service life of an LM System refers to the total travel distance until the first event of flaking due to rolling fatigue of the material occurs on the raceway or the rolling element.

Nominal Life

The service life of an LM System is subject to slight variations even under the same operating conditions. Therefore, it is necessary to use the nominal life defined below as a reference value for obtaining the service life of the LM System.
The nominal life means the total travel distance that 90% of a group of identical LM System units can achieve without flaking.

Basic Load Rating

An LM System has two types of basic load ratings: basic dynamic load rating (C), which is used to calculate the service life, and basic static load rating (C_0), which defines the static permissible limit.

Basic Dynamic Load Rating C

The basic dynamic load rating (C) indicates the load with constant direction and magnitude, under which the rated life (L) is L = 50 km for an LM System using balls, or L = 100 km for an LM System using rollers, when a group of identical LM System units independently operate under the same conditions.
The basic dynamic load rating (C) is used to calculate the service life when an LM System operates under a load.

Note: Specific values of each LM System model are indicated in the dimensional table for the corresponding model number.

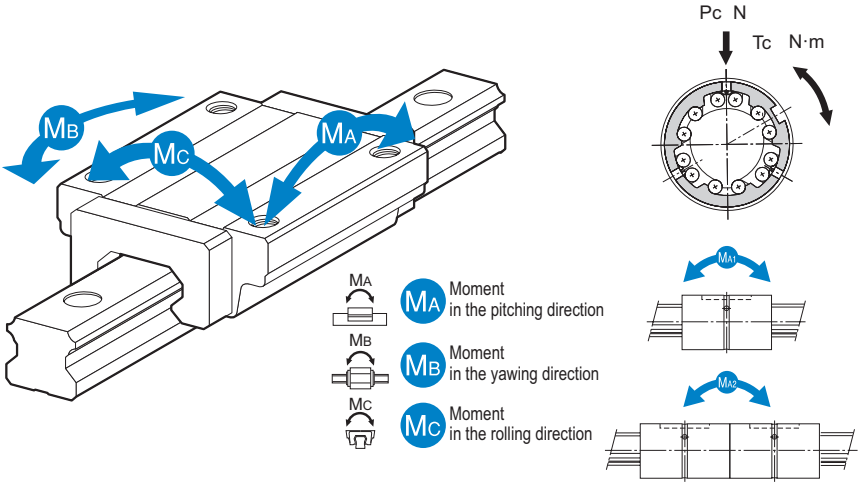
Basic Static Load Rating C_0

If an LM System receives an excessively large load or a large impact when it is stationary or operative, permanent deformation occurs between the raceway and the rolling element. If the permanent deformation exceeds a certain limit, it will prevent the LM System from moving smoothly.
The basic static load rating is a static load with a constant direction and magnitude whereby the sum of the permanent deformation of the rolling element and that of the raceway on the contact area under the maximum stress is 0.0001 times the rolling element diameter. With an LM System, the basic static load rating is defined for the radial load.
The basic static load rating C_0 is used for calculating the static safety factor relative to the working load.

Note: Specific values of each LM System model are indicated in the dimensional table for the corresponding model number.

Static Permissible Moment M_0

When an LM System receives a moment, the rolling elements on both ends receive the maximum stress due to uneven distribution of the stress on the rolling elements within the LM System.
The permissible static moment (M_0) means the moment with constant direction and magnitude, under which the sum of the permanent deformation of the rolling element and the permanent deformation of the raceway is 0.0001 times the rolling element's diameter in the contact area where the maximum stress is applied.
With an LM System, the static permissible moment is defined in three directions: M_A, M_B, and M_C.



P_C : Radial load
T_C : Moment in the torque direction
M_{A1} : Moment in the pitching direction
M_{A2} : Moment in the pitching direction

Note: The specific static permissible moment value of each LM System model is provided in the section on the permissible moments of each model.

Static Safety Factor f_S

When an LM System is stationary or in motion, an unexpected external force may be applied due to vibrations, impacts, or inertia caused by starting and stopping. It is necessary to take a static safety factor into account with regard to this type of applied load.

Static Safety Factor f_S

The static safety factor (f_S) is determined by the ratio of the load capacity (basic static load rating C_0) of an LM System to the load applied on the LM System.

$$f_S = \frac{f_C \cdot C_0}{P} \quad \text{or} \quad f_S = \frac{f_C \cdot M_0}{M} \quad \cdots\cdots\cdots (1)$$

f_S : Static safety factor
f_C : Contact factor (see Table 1 on B0-12)
C_0 : Basic static load rating
M_0 : Static permissible moment (M_A, M_B and M_C)
P : Calculated load
M : Calculated moment

Life Calculation Formula

Calculating the Nominal Life

The nominal life (L_{10}) of an LM System is obtained from the following formulas using the basic dynamic load rating (C), which is based on a reference distance of 50 km for an LM System with balls and 100 km for an LM System with rollers, and the calculated load acting on the LM System (P_C).

- An LM System with balls (using a basic dynamic load rating based on a nominal life of 50 km)

$$L_{10} = \left(\frac{C}{P}\right)^3 \times 50 \quad \cdots\cdots\cdots\cdots (1)$$

L_{10} : Nominal life (km)
C : Basic dynamic load rating (N)
P : Applied load (N)

- An LM System with rollers (using a basic dynamic load rating based on a nominal life of 100 km)

$$L_{10} = \left(\frac{C}{P}\right)^{\frac{10}{3}} \times 100 \cdots\cdots\cdots\cdots (2)$$

Note: These nominal life formulas may not apply if the length of the stroke is less than or equal to twice the length of the effective load range.

When comparing the nominal life (L_{10}), you must take into account whether the basic dynamic load rating was defined based on 50 km or 100 km. Convert the basic dynamic load rating based on ISO 14728-1 as necessary.

ISO-regulated basic dynamic load rating conversion formulas:

- LM System with balls

$$C_{100} = \frac{C_{50}}{1.26}$$

- LM System with rollers

$$C_{100} = \frac{C_{50}}{1.23}$$

C_{50} : Basic dynamic load rating based on a nominal life of 50 km
C_{100} : Basic dynamic load rating based on a nominal life of 100 km

Calculating the Modified Nominal Life

During use, an LM System may be subjected to vibrations and shocks as well as fluctuating loads, which are difficult to detect. In addition, the hardness of the raceways, the operating temperature, and having more than one LM System arranged in close contact will have a decisive impact on the service life. Taking these factors into account, the modified nominal life (L_{10m}) can be calculated according to the following formulas (3) and (4).

●Modified factor α

$$\alpha = \frac{f_H \cdot f_T \cdot f_C}{f_W}$$

α : Modified factor
f_H : Hardness factor (see Fig.1 on B**0-11**)
f_T : Temperature factor (see Fig. 2 on B**0-11**)
f_C : Contact factor (see Table 1 on B**0-12**)
f_W : Load factor (see Table 2 on B**0-12**)

●Modified nominal life L_{10m}

• LM System with balls

$$L_{10m} = \left(\alpha \times \frac{C}{P}\right)^3 \times 50 \quad \cdots\cdots\cdots(3)$$

• LM System with rollers

$$L_{10m} = \left(\alpha \times \frac{C}{P}\right)^{\frac{10}{3}} \times 100 \quad \cdots\cdots\cdots(4)$$

L_{10m}	: Modified nominal life	(km)
C	: Basic dynamic load rating	(N)
P	: Applied load	(N)

● f_H: Hardness Factor

To maximize the load capacity of the LM System, the hardness of the raceways needs to be between 58 and 64 HRC.
If the hardness is lower than this range, the basic dynamic load rating and the basic static load rating decrease. Therefore, it is necessary to multiply each rating by the respective hardness factor (f_H).

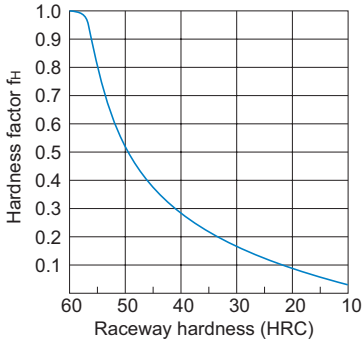


Fig.1: Hardness Factor (f_H)

● f_T:Temperature Factor

If the temperature of the environment surrounding the operating LM System exceeds 100℃, take into account the adverse effect of the high temperature and multiply the basic load ratings by the temperature factor indicated in Fig. 2.
In addition, the LM System must be of a high-temperature type.

Notes: If the temperature of the service environment exceeds 80℃, it is necessary to change the materials of the seal and end plate to high-temperature materials.
If the temperature of the environment exceeds 120℃, it is necessary to provide dimensional stabilization.
A Caged Ball LM Guide or Caged Roller LM Guide may not be used in such an environment because their operating temperature is 80°C or below.

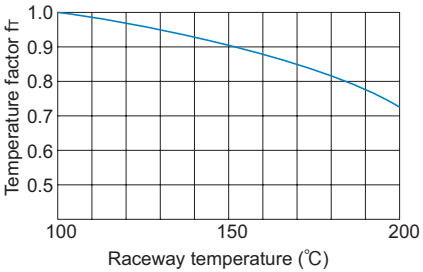


Fig. 2: Temperature Factor (f_T)

● f_c: Contact Factor

If multiple LM Guide blocks are closely arranged with each other, it is difficult to achieve uniform load distribution due to a moment load and the accuracy of the mounting surface. In such applications, multiply basic load ratings "C" and "C_0" by the corresponding contact factors in Table 1.

Note: If uneven load distribution is expected in a large machine, take into account the respective contact factor indicated in Table 1.

Table 1: Contact Factor (f_c)

Number of blocks used in close contact	Contact factor f_c
2	0.81
3	0.72
4	0.66
5	0.61
6 or greater	0.6
Normal use	1

● f_w: Load Factor

In general, reciprocating machines tend to involve vibrations or impacts during operation. It is extremely difficult to accurately determine vibrations generated during high-speed operation and impacts that occur during frequent starts and stops. Therefore, where the effects of speed and vibration are estimated to be significant, divide the basic dynamic load rating (C) by a load factor selected from Table 2, which contains empirically obtained data.

Table 2: Load Factor (f_w)

Vibrations/ impacts	Speed (V)	f_w
Faint	Very low V≦0.25 m/s	1 to 1.2
Weak	Slow 0.25 m/s<V≦1 m/s	1.2 to 1.5
Medium	Medium 1 m/s<V≦2 m/s	1.5 to 2
Strong	High V>2 m/s	2 to 3.5

Rigidity

When using an LM System, it is necessary to select a type and a clearance (preload) suitable to the service conditions in order to achieve the required rigidity of the machine/equipment.

Selecting a Clearance/Preload for an LM System

Since the clearances and preload standards of each LM System are set individually by model, you can select a clearance and a preload according to the operating conditions.
For separate-type models, THK cannot adjust their clearances at shipment. Therefore, the user must adjust the clearance when installing the product.
Determine a clearance/preload while referring to the following section.

Clearance and Preload

Clearance (Internal Clearance)

Clearance of an LM System is a play between the block (nut), the rail (shaft), and the ball (or roller). The sum of vertical clearances is called radial clearance, and the sum of circumferential clearances is called angular backlash (clearance in the rotational direction).

(1) Radial clearance
With the LM Guide, a radial clearance refers to the value of movement of the block center when the LM block is gently moved vertically with constant force applied in the center of the fixed LM rail in the longitudinal direction.

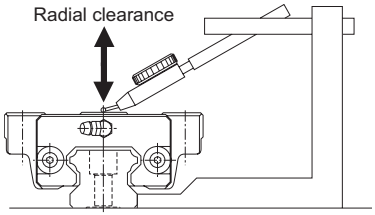


Fig. 3: Radial Clearance of the LM Guide

(2) Angular backlash (clearance in the rotational direction)
With the ball spline, angular backlash (clearance in the rotational direction) refers to the value of rotational motion of the nut when the spline shaft is fixed and the nut is gently rotated forward and backward with constant force.

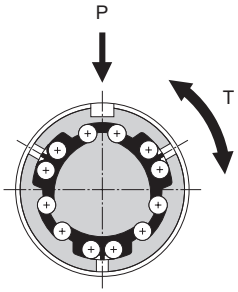


Fig. 4: Angular Backlash of the Ball Spline

Preload

Preload is a load that is preliminarily applied to the rolling elements in order to eliminate the clearance in an LM System and increase its rigidity.
A negative clearance indication (negative value) in an LM System means that a preload is provided.

Table 3: Examples of Radial Clearances for LM Guide Model HSR
Unit: μm

Indication symbol	Normal	Light preload	Medium preload
Model No.	No symbol	C1	C0
HSR 15	–4 to +2	–12 to –4	—
HSR 20	–5 to +2	–14 to –5	–23 to –14
HSR 25	–6 to +3	–16 to –6	–26 to –16
HSR 30	–7 to +4	–19 to –7	–31 to –19
HSR 35	–8 to +4	–22 to –8	–35 to –22

Note: For specific clearances and preloads, see the section concerning the corresponding model.

Preload and Rigidity

Providing a preload to an LM System will increase the rigidity according to the amount of the preload. Fig. 5 shows the amount of deflection for each clearance (normal clearance, C1 clearance, and C0 clearance) in LM Guide Model HSR.

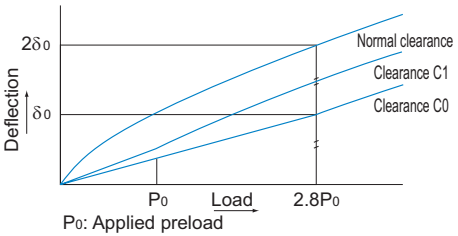


Fig. 5: Rigidity Data

Thus, the effect of a preload is up to approximately 2.8 times that of the applied preload itself. With a preload, the deflection under a given load is smaller and the rigidity is much greater than that without a preload.

Fig. 6 shows how the radial deflection of an LM Guide changes with a preload. As indicated in Fig. 6, when an LM Guide block receives a radial load of 2.45 kN, the radial deflection is 9 μm if the radial clearance is zero (normal clearance) or 2 μm if the radial clearance is -30 μm (clearance C0), thus increasing the rigidity by 4.5 times.

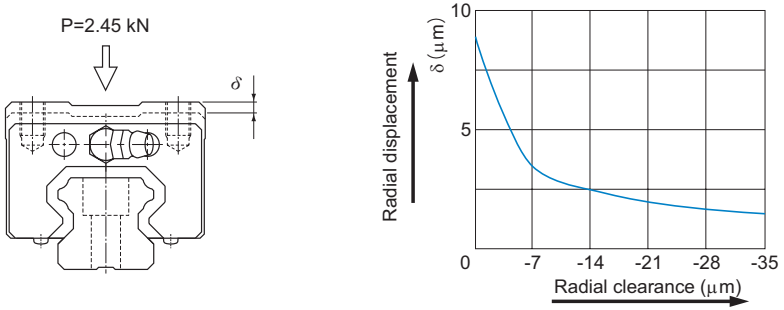


Fig. 6: Radial Clearance and Deflection

Note: For selecting a specific clearance, see the section concerning selection of a radial clearance for the corresponding LM System model.

Friction Coefficient

Since an LM System achieves rolling motion via rolling elements such as balls and rollers placed between the raceways, its frictional resistance is 1/20 to 1/40 that of a sliding guide. Its static friction is especially small and almost the same as dynamic friction, preventing the system from experiencing stick-slip. Therefore, the system is capable of being moved by submicron increments.
The frictional resistance of an LM System varies according to the type of the LM System, its preload, the viscosity resistance of the lubricant, and the load applied on the LM System.
In particular, when a moment is given or a preload is applied to increase rigidity, the frictional resistance increases.
The normal friction coefficient for each LM System is indicated in Table 4.

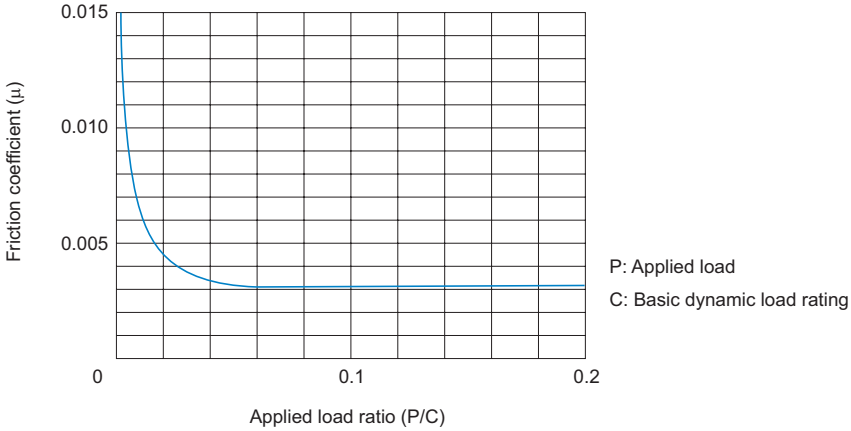


Fig. 7: Relationship between Applied Load Ratio and Frictional Resistance

Table 4: Frictional Resistances (μ) of each type of LM System

Type of LM System	Representative models	Frictional resistance (μ)
LM Guide	SHS, SSR, SRS, HSR, NR/NRS, RSR	0.002 to 0.003
	SRG, SRN	0.001 to 0.002
Ball spline	LBS, LBF, LT, LF	0.002 to 0.003
Linear bushing	LM, LMK, LMF, SC	0.001 to 0.003
LM stroke	MST, ST	0.0006 to 0.0012
LM roller	LR, LRA	0.005 to 0.01
Flat roller	FT, FTW	0.001 to 0.0025
Cross-roller guide/cross-roller table	VR, VRU, VRT	0.001 to 0.0025
Linear ball slide	LS	0.0006 to 0.0012
Cam follower/roller follower	CF, NAST	0.0015 to 0.0025

Accuracy

The motion accuracy of an LM System is defined in running accuracy for applications that are fixed on a flat surface and in runout accuracy for applications whose shafts are supported, with accuracy grades established for each of them.
For details, see the page concerning the corresponding application.

Lubrication

To optimize the functionality of an LM System, it is necessary to provide lubrication that suits the operating conditions. Use without lubrication may increase wear on the rolling elements and shorten the service life.
Lubrication has the following effects:
(1) Minimizes friction between moving elements to prevent seizure and reduce wear
(2) Forms an oil film on the raceway to decrease stress acting on the surface and extend rolling fatigue life
(3) Covers metal surfaces with an oil film to prevent the formation of rust
Even when the LM System has seals, the internal lubricant gradually seeps out during operation. Therefore, the system needs to be lubricated at an appropriate interval according to the operating conditions.
For the lubrication, see the section beginning B**24-1**.

Types of Lubricants

A typical LM System uses grease or sliding surface oil for its lubricant.
The requirements that lubricants need to satisfy generally consist of the following:
(1) Extreme pressure resistance
(2) Reduces friction
(3) High wear resistance
(4) High thermal stability
(5) Excellent rust-proofing performance
(6) Excellent fluidity
(7) Stable consistency even with repeated stirring

Table 5: Lubricants for General Use

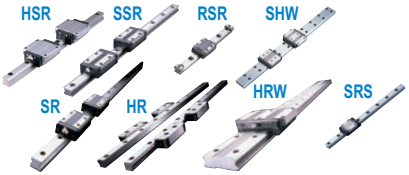
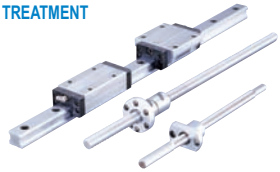
Lubricant	Type	Brand name
Oil	Sliding surface oil or turbine oil ISOVG32 to 68	Daphne Super Multi Oil (Idemitsu) Mobil Vactra Oil Numbered Series (Exxon Mobil) Mobil Vactra Oil No. 2 SLC (Exxon Mobil) Mobil DTE Oil Series (Exxon Mobil) Shell Tonna S3 M (Showa Shell Sekiyu) Equivalent product

Table 6: Lubricants Used in Special Environments

Operating environment/conditions	Lubrication	THK product
Environments with spattering coolant	– To stop the coolant from causing emulsification, use grease that does not easily wash away. – Use grease with extreme pressure and rust-proofing performance. Note: In environments where water-soluble coolants may spatter, there are occasions where certain types of coolant may cause emulsification or cause the grease to wash away, even if using medium-viscosity lubricant. This, in turn, may then reduce lubricity and prevent a proper oil film from forming. Check the compatibility between the lubricant and coolant. ● Daphne Super Multi Oil (Idemitsu) ● Mobil Vactra Oil No. 2 SLC (Exxon Mobil)	– Please note that applying coolant directly to THK products may have an adverse effect on components/parts made of resin, rubber, etc. – Consider using designs where coolant cannot come into direct contact with THK products (consider using covers or bellows). – Consider using some of the various contamination protection options available in order to prevent coolant from getting inside THK products.
High-temperature environments	– Please note that the higher the temperature, the greater the risk of the grease separating and the lubrication performance dropping.	– Contact THK for a range of products with high-temperature specifications.
Clean rooms	– THK also offers a range of grease products compatible with clean rooms. ● AFE-CA Grease (THK) ● AFF Grease (THK) ● L100 Grease (THK) Note: This product cannot be used in Europe.	– Two reasons for the generation of dust are metal-to-metal contact and mutual friction between rolling elements. THK offers a range of products with ball cages that minimize metal-to-metal contact and mutual friction between the rolling elements. Furthermore, the ball cage is also structured in a way that maintains the lubricity, making it suitable for use in clean rooms. – Anti-rust oil is applied as standard, so please specify if it is not required.
Vacuum environments	– Use fluorinated lubricants for vacuums (vapor pressure varies by brand). – Using vacuum grease will make it more likely that the oil film will break due to its low extreme pressure resistance compared to general industrial grease. Be sure that there is a reliable feeding of oil to the raceways (by increasing the number of relubrications, etc.) in order to ensure that the oil film does not break. Note: If using vacuum greases, please note that some brands have starting resistances several times greater than general-purpose grease.	– Please note that under vacuum environments, there is a risk that gas given off by resin and rubber materials may cause the vacuum level to decrease. – Please consider using stainless steel or surface-treated products as a rust-proofing measure.
High-speed moving parts	– Use a lubricant with a low base oil kinematic viscosity to prevent heat generated by resistance from the lubricant. – THK offers a range of grease products with excellent high-speed specifications. ● AFA Grease (THK) ● AFG Grease (THK) ● AFJ Grease (THK)	– Metal-to-metal contact and mutual friction between the rolling elements inside products may produce noise and lead to premature failure of the product. – THK offers a range of caged products with excellent high-speed and noise-dampening properties.
Environments with water	– Use grease with high water-proofing properties. – Use a lubricant with high extreme pressure resistance that does not easily wash away. ● L700 Grease (THK) Note: This product cannot be used in Europe. – Contact THK for instructions regarding lubricating in and around water.	– Consider using designs where water cannot come into contact with THK products. (Consider using bellows or covers.) – Consider using stainless steel or surface-treated products as a rust-proofing measure. – Consider using some of the various contamination protection options available in order to prevent water from getting inside the product.
Food machinery	– Consider using grease that is made for food processing and that is safe for people. ● L700 Grease (THK) (NSF H1 standard accredited)	– Consider using covers if there is the possibility of lubricant spattering.
Micro-vibrations	– THK offers a range of grease products that work particularly well under micro-vibrations. ● AFC Grease (THK) ● AFJ Grease (THK)	– Oil films formed at the points of contact between the rolling elements and raceway are likely to break in environments with micro-vibrations. – By periodically overstroking, the lubricant will form an oil film at the points of contact between the rolling elements and raceway.

Protecting an LM System

An LM System may be used in a variety of environments. If using an LM System in a special environment such as a vacuum, a corrosive environment, or extreme heat or cold, it is necessary to select a material and surface treatment that suit the service environment.
To support use in various special environments, THK offers the following materials and surface treatments for each type of LM System.

	Description	Model No.	Features and capabilities
Material	Martensitic stainless steel	HSR SSR RSR SHW SR HR HRW SRS 	Corrosion resistance ★★★
Material	Martensitic stainless steel	SR-M1 HSR-M1 RSR-M1 	High temperature ★★★★★ Note: up to 150℃
Material	Austenitic stainless steel	HSR-M2 	Corrosion resistance ★★★★★
Surface treatment	AP-HC	THK AP-HC TREATMENT 	Low dust generation ★★★★★ Corrosion resistance ★★★ Surface hardness ★★★★★
Surface treatment	AP-C	THK AP-C TREATMENT 	Corrosion resistance ★★★★
Surface treatment	AP-CF	THK AP-CF TREATMENT 	Corrosion resistance ★★★★★

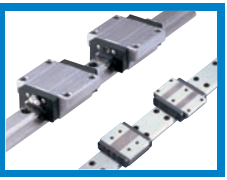
Note: If you desire a surface treatment other than the above, contact THK.

Selecting a Material

When operating under normal service conditions, THK's linear motion products use types of steel best suited to use in an LM System. However, if using an LM System in a special environment, it is necessary to select a material that suits the service environment.
For locations that require corrosion resistance, stainless steel is used.

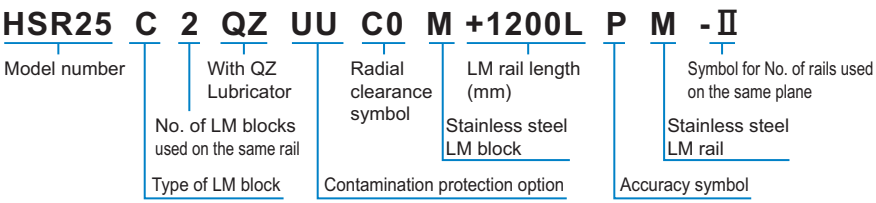
Material Specifications
Stainless Steel Products

●Material: Martensitic stainless steel, austenitic stainless steel, or THK-EX50



For use in environments where corrosion resistance is required, some LM System models can use martensitic or austenitic stainless steel.
THK has also developed THK-EX50, a martensitic stainless steel material that meets JIS corrosion resistance standards, specifically for LM systems.
Furthermore, this material can achieve the hardness required of an LM system, and so offers exceptional service life.
If the model number of an LM System contains symbol M, it means that the model is made of stainless steel. See the section concerning the corresponding model.

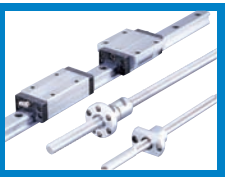
Model number coding



Surface Treatment

The surfaces of the rails and shafts of an LM System can be treated for anti-corrosive or aesthetic purposes.
THK offers THK-AP treatment, which is the optimum surface treatment for an LM System.
The THK-AP treatment consists of the following three types.

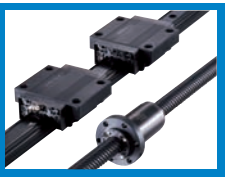
AP-HC



- **Surface treatment: industrial-use hard chrome plating**
- **Film hardness: 750 HV or higher**

Equivalent to industrial-use hard chrome plating, AP-HC achieves almost the same level of corrosion resistance as martensitic stainless steel. In addition, it is highly resistant to wear since the film is extremely hard, 750 HV or higher.

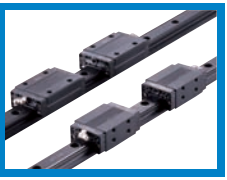
AP-C



- **Surface treatment: industrial-use black chrome coating**

A type of industrial-use black chrome coating designed to increase corrosion resistance. It achieves lower cost and higher corrosion resistance than martensitic stainless steel.

AP-CF



- **Surface treatment: industrial-use black chrome coating/ special fluorocarbon resin coating**

A compound surface treatment that combines black chrome coating and special fluorine resin coating and is suitable for applications requiring high corrosion resistance.
In addition to the above options, other surface treatments are sometimes performed on areas other than the raceways, such as alkaline coloring treatment (black oxidizing) and colored alumite treatment. However, some of them are not suitable for use in an LM System. For details, contact THK.
If using an LM System whose raceways are surface treated, set a higher safety factor.

Model number coding

SR15 V 2 F + 640L F

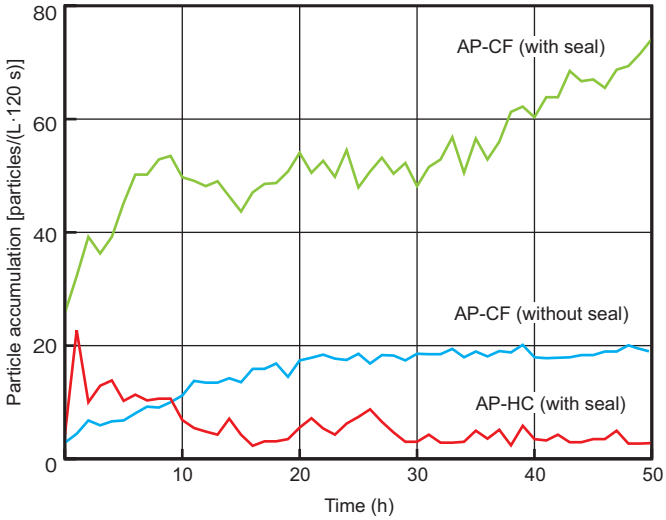
- SR15: Model number
- V: Type of LM block
- 2: No. of LM blocks used on the same rail
- F: With surface treatment on the LM block
- 640L: LM rail length (mm)
- F: With surface treatment on the LM rail

Note: Note that the inside of the mounting hole is not provided with surface treatment.

Data on Comparison of Dust Generation with AP Treatment

Test Conditions

Item	Description
LM Guide model number	SSR20WF+280LF (AP-CF, without seal)
	SSR20UUF+280LF (AP-CF, with seal)
	SSR20WUUF+280LF (AP-HC, with seal)
Grease used	THK AFE-CA Grease
Grease volume	1 cc (per LM block)
Speed	30 m/min (max)
Stroke	200 mm
Flow rate during measurement	1 L/120 s
Clean room volume	1.7 L (acrylic casing)
Measuring instrument	Dust counter
Measured particle diameter	0.3 μm or more



THK AP-HC treatment provides high surface hardness and has high wear resistance. The high level of wear in the early stage in the graph above is considered to be due to the initial wear of the end seal.

Note: THK AP-HC treatment (equivalent to hard chrome plating)
THK AP-CF treatment (equivalent to black chrome plating + fluorine resin coating)

Data on Comparison of Rust Prevention

Salt-Water Spray Resistance Cycle Test

Item	Description
Spray liquid	1% NaCl solution
Cycles	Spraying for 6 h, drying for 6 h
Temperature conditions	35℃ during spraying
	60℃ during drying

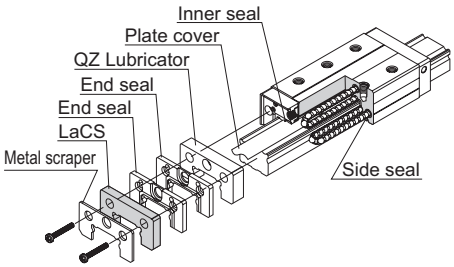
Specimen material / Time		Austenitic stainless steel	Martensitic stainless steel	THK AP-HC	THK AP-C	THK AP-CF
Before test						
6 hours						
24 hours						
96 hours						
Test results	Anti-rust property	◎	○	○	◎	◎
	Wear resistance	○	◎	◎	△	○
	Surface hardness	△	◎	◎	△	△
	Adherence	—	—	◎	△	○
	Appearance	Metallic luster	Metallic luster	Metallic luster	Black luster	Black luster

Contamination Protection

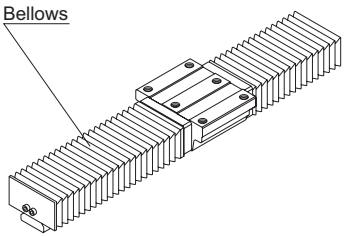
Contamination protection is the most important factor in using an LM System. Entrance of dust or other foreign material into the LM System will cause abnormal wear or shorten the service life. Therefore, when entrance of dust or other foreign material is a possibility, it is necessary to select a sealing device or contamination protection option that meets the service environment conditions.

(1) Dedicated seals for use in an LM System
Seals made of special synthetic rubber with high wear resistance (e.g., Laminated Contact Scraper LaCS) and a wiper ring are available as contamination protection seals for an LM System.
For locations with severe environments, dedicated bellows and dedicated covers are available for some models.
For details and the symbols that represent these seals, see the section concerning options (contamination protection) for the corresponding model.
To provide contamination protection for ball screws in service environments subject to cutting chips and cutting fluids, it is advisable to use a telescopic cover that protects the whole system and a large-sized bellows.

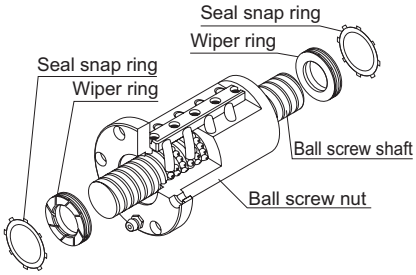
(2) Dedicated bellows
Standardized bellows are available for the LM Guide.
THK also manufactures dedicated bellows for other LM System products such as ball screws and ball splines. Contact THK for details.



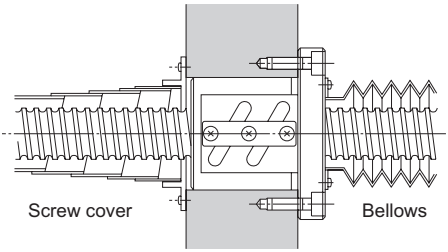
Contamination Protection Seals for the LM Guide



Dedicated Bellows for the LM Guide



Wiper Ring for the Ball Screw



Contamination Protection Cover for the Ball Screw