General Description

THK General Catalog

B Support Book

Selection Flow Chart

1. Setting Conditions

- Dimensions of machines and systems
- Space in the guide section
- Installation direction (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 meets the 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

- Selecting size
- Selecting a number of blocks/nuts
- Determining a number of rails/shafts

4. Rigidity

- Selecting clearance
- Selecting preload
- Determining a fixing method
- Determining the rigidity of the mounting section

5. Accuracy

- Selecting an accuracy grade (feeding accuracy, runout accuracy)
- Accuracy of the mounting surface

6. Lubrication and Safety Design

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

7. Calculating the Thrust Force

- Obtaining the thrust force required for linear motion

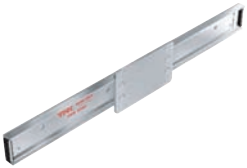
Selection Completed

Types and Features of LM Systems

Type	LM Guide	Ball Spline	Linear Bushing
Appearance			
Features	• Ideal Four Raceway, Circular-Arc Groove, Two-Point Contact Structure • Superb error-absorbing capability with the DF design • Accuracy Averaging Effect 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 Retaining Type	• Interchangeable type • LM system capable of performing infinite linear motion at low price
Stroke	Infinite stroke	Infinite stroke	Infinite stroke
Major Applications	• Surface grinder • Electric discharge machine • High-speed transfer equipment • NC lathe • Injection molding machine • Woodworking machine • Semiconductor manufacturing equipment • Inspection equipment • Food-related machine • Medical equipment	• Z axis of assembly robot • Automatic loader • Transfer machine • Automatic conveyance system • Wire winder • Spindle drive shaft of grinding machine • Steering of construction vehicle • Blood test equipment • ATC • Golf training machine	• Measuring instruments • Digital 3D measuring instrument • Printing machine • OA equipment • Automatic vending machine • Medical equipment • Food packaging machine
Page introducing the product	B1-1 onward	B3-1 onward	B4-1 onward

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 lightweight type • Reduced design and assembly costs	• Long service life, high rigidity • Easy clearance adjustment type
Stroke	Finite stroke	Infinite stroke	Finite stroke
Major Applications	• Press die setting • Ink roll unit of printing machine • Optical measuring instrument • Spindle • Solenoid valve guide • Press post guide • Load cell • Photocopiers • Inspection machines	• Magnetic disc device • Electronic equipment • Semiconductor manufacturing equipment • Medical equipment • Measuring equipment • Plotting machine • Photocopier	• Measuring instruments • Insertion machine • Printed circuit board drilling machine • Inspection equipment • Small stage • Handling mechanism • Automatic lathe • Tool grinder • Internal grinding machine • Small surface grinding machine
Page introducing the product	B5-1 onward	B6-1 onward	B7-1 onward

Type	Cross Roller Table	Linear Ball Slide	LM Roller
Appearance			
Features	• Easily installable unit type • Allows selection of diverse uses	• Easily installable unit type • Lightweight and Compact • Capable of performing rolling motion with an extremely small friction coefficient • Low cost	• Compact, large load capacity type • Self skewing-adjusting type
Stroke	Finite stroke	Finite stroke	Infinite stroke
Major Applications	• Measuring equipment stage • Optical stage • Tool grinder • Printed circuit board drilling machine • Medical equipment • Automatic lathe • Internal grinding machine • Small surface grinding machine	• Small electronic part assembly machine • Handler • Automatic recorder • Measuring equipment stage • Optical stage • Medical equipment	• Precision press ram guide • Press metal mold exchanger • Heavy load conveyor systems • Vendor machine
Page introducing the product	B8-1 onward	B9-1 onward	B10-1 onward

Type	Flat Roller	Slide Pack	Slide Rail
Appearance			
Features	• Large Load Capacity • Combined accuracy of 90° V-shape surface and flat surface available as standard	• Interchangeable type • Low-cost, simple type	• Thin, compact design • Low-cost, simple type • High strength, high durability
Stroke	Finite stroke	Infinite stroke	Finite stroke
Major Applications	• Planer • Horizontal milling machine • Roll grinding machine • Surface grinder • Cylindrical grinder • Optical measuring instrument	• Amusement machine • High-grade furniture • Light and heavy doors • Tool cabinet • Kitchen fitments • Automatic feeder • Computer peripherals • Photocopier • Medical equipment • Office equipment	• Amusement machine • High-grade furniture • Light and heavy doors • Office equipment • Store fixture • Stocker
Page introducing the product	B11-1 onward	B12-1 onward	B13-1 onward

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. If a limit is reached, 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 occurs due to rolling fatigue of the material 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.

Specific values of each LM system model are indicated in the specification table for the corresponding model number.

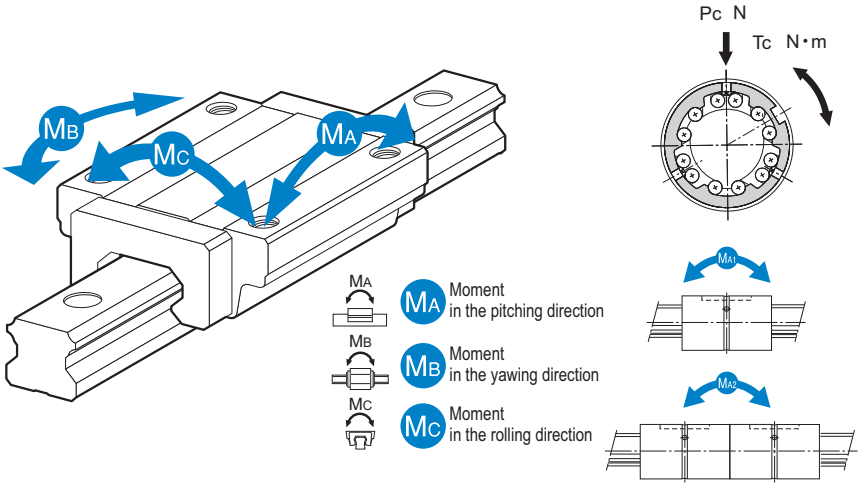
Basic Static Load Rating C_0

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 performing smooth motion.
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.

Specific values of each LM system model are indicated in the specification 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 accounts for 0.0001 times of 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
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

The Linear Motion system may receive an unexpected external force while it is stationary or operative due to the generation of an inertia caused by vibrations and impact or start and stop. It is necessary to consider a static safety factor against such a working 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 Table2 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

[Measure of Static Safety Factor]

Refer to the static safety factor in Table1 as a measure of the lower limit under the service conditions.

Table1 Measure of Static Safety Factor

Kinetic conditions	Load conditions	Lower limit of f_S
Constantly stationary	Impact is small, and deflection of the rail is also small	1.0 to 3.5
	Impact is present, and a twisting load is applied	2.0 to 5.0
Normal motion	A normal load is applied, and the deflection of the rail is small	1.0 to 4.0
	Impact is present, and a twisting load is applied	2.5 to 7.0

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).

- LM systems with balls (Using a basic dynamic load rating based on a nominal life of 50 km)

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

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

- LM systems with rollers (Using a basic dynamic load rating based on a nominal life of 100 km)

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

*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 LM systems 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 Table2 on B**0-12**)
f_W : Load factor (see Table3 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).

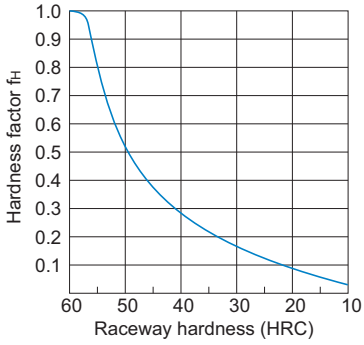


Fig.1 Hardness Factor (f_H)

● 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 high temperature type.

Note) 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.
Note) If the temperature of the environment exceeds 120℃, it is necessary to provide dimensional stabilization.
Note) They are not used because the operating temperature for caged ball LM guides and caged roller LM guides is 80°C or below.

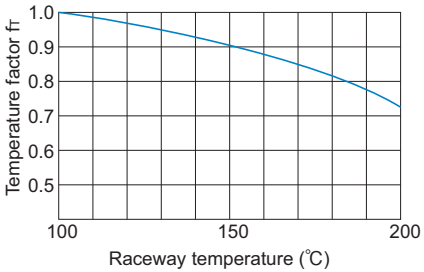


Fig.2 Temperature Factor (f_T)

● 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 Table2.

Note) If uneven load distribution is expected in a large machine, take into account the respective contact factor indicated in Table2.

Table2 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 impact during operation. It is extremely difficult to accurately determine vibrations generated during high-speed operation and impact during frequent start and stop. 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 Table3, which contains empirically obtained data.

Table3 Load Factor (f_w)

Vibrations/ impact	Speed(V)	f_w
Faint	Very low $V \leqq 0.25$m/s	1 to 1.2
Weak	Slow $0.25 < V \leqq 1$m/s	1.2 to 1.5
Medium	Medium $1 < V \leqq 2$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) that meet the service conditions in order to achieve the required rigidity of the machine/equipment.

Selecting a Clearance/Preload for an LM System

Since clearances and preloads of LM systems are standardized for different models, you can select a clearance and a preload according to the service 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 a 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.

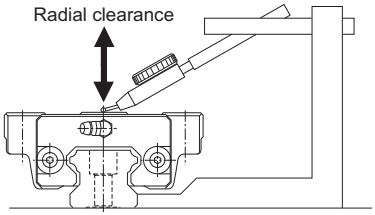


Fig.3 Radial clearance of the LM Guide

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

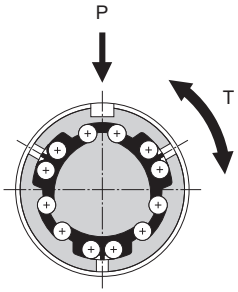


Fig.4 Angular backlash of the Ball Spline

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

Table4 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

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 deflection of clearances (normal clearance, clearance C1 and clearance C0) (with LM Guide model HSR).

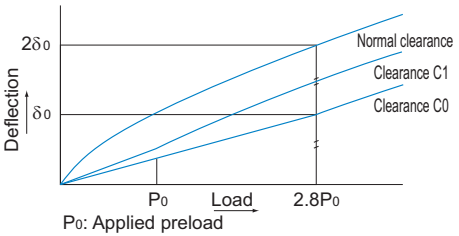


Fig.5 Rigidity Data

Thus, a preload has an effect of up to approximately 2.8 times greater than the applied preload itself. The deflection with a preload 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 9μm if the radial clearance is zero (normal clearance) or 2μm if it the radial clearance is -30μm (clearance C0), thus increasing the rigidity by 4.5 times.

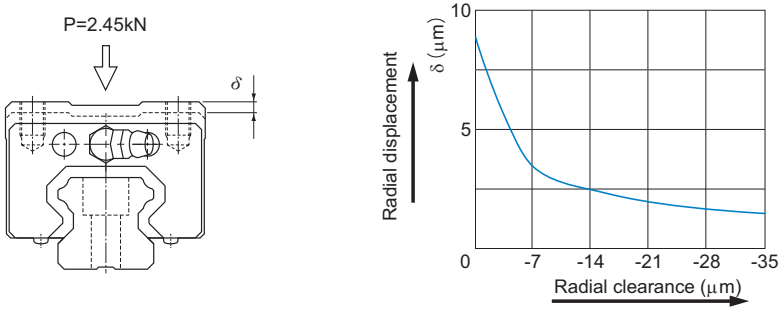


Fig.6 Radial Clearance and Deflection

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 makes rolling motion via its rolling elements such as balls and rollers between the raceways, its frictional resistance is 1/20 to 1/40 smaller than 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 fed by the submicron distance.
The frictional resistance of an LM system varies according to the type of the LM system, preload, 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.
Normal friction coefficient by LM systems are indicated in Table5.

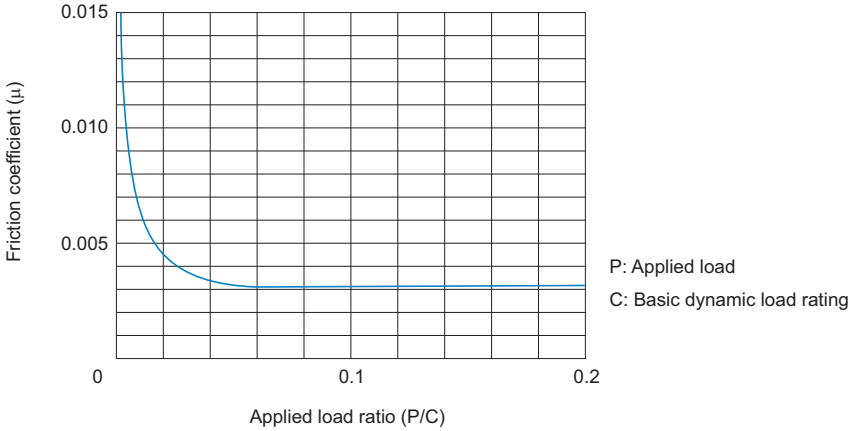


Fig.7 Relationship between Applied Load Ratio and Frictional Resistance

Table5 Frictional Resistances (μ) of LM Systems

Types of LM systems	Representative types	Frictional resistance (μ)
LM Guide	SSR, SHS, SRS, RSR, HSR, NR/NRS	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 the flat surface and in runout accuracy for applications whose shafts are supported, and accuracy grades are established for each of them.
For details, see the page concerning the corresponding application.

Lubrication

To optimize an LM system's functionality, it is necessary to provide lubrication according to the usage 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 usage conditions.
For the lubrication, see the section beginning B**24-1**.

[Types of Lubricants]

LM systems mainly use grease or sliding surface oil for their lubricants.
The requirements that lubricants need to satisfy generally consist of the following:
(1) Extreme pressure resistance
(2) Reduce friction
(3) High wear resistance
(4) High thermal stability
(5) Excellent rust-proofing performance
(6) Excellent fluidity
(7) Consistency of grease must not vary significantly even with repeated stirring

Table6 Lubricants for General Use

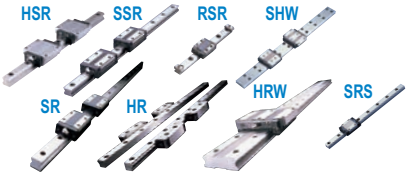
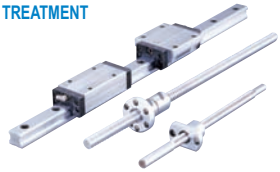
Lubricant	Type	Brand name
Oil	Sliding surface oil or turbine oil ISOVG32 to 68	Daphne Super Multi Oil (Idemitsu) Mobil Vactra Oil Numbered Series (Exxon Mobil) Mobil Vactra Oil No. 2 SLC (Exxon Mobil) Mobil DTE Oil Series (Exxon Mobil) Shell Tonna S3 M (Showa Shell Sekiyu) Equivalent product

Table7 Lubricants Used under Special Environments

Usage 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. * 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 dust-proofing options available in order to prevent coolant from getting inside THK products.
High-temperature environment	– 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 high-temperature specification products.
Clean room	– THK also offers a range of clean room-compatible grease products. ● AFE-CA Grease (THK) ● AFF Grease (THK) ● L100 Grease (THK)	– 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 a cage for minimizing metal-to-metal contact and mutual friction between the rolling elements. Furthermore, the 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. * 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 quickly lead to damage. – 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) – 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 dust-proofing 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-vibration	– 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.

Safety Design

LM systems are used in various environments. If using an LM system in a special environment such as vacuum, anti corrosion, high temperature and low temperature, 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 LM systems.

	Description	Model No.	Features/Capabilities
Material	Martensite stainless steel	HSR SSR RSR SHW SR HR HRW SRS 	Corrosion Resistance ★★★
	Martensite stainless steel	SR-M1 HSR-M1 RSR-M1 	High temperature ★★★★★ *up to 150℃
	Austenite stainless steel	HSR-M2 	Corrosion Resistance ★★★★★
Surface Treatment	AP-HC	THK AP-HC TREATMENT 	Low dust generation ★★★★★ Corrosion Resistance ★★★ Surface hardness ★★★★★
	AP-C	THK AP-C TREATMENT 	Corrosion Resistance ★★★★
	AP-CF	THK AP-CF TREATMENT 	Corrosion Resistance ★★★★★

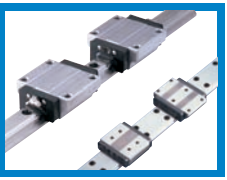
*If you desire a surface treatment other than the above, contact THK.

Determining a Material

In normal service conditions, LM systems use a type of steel that suits LM systems. 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 high corrosion resistance, a stainless steel material is used.

Material Specifications
Stainless Steel LM Systems

●Material···Martensite stainless steel/austenite stainless steel



For use in environments where corrosion resistance is required, some LM system models can use martensite stainless steel.
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

HSR25 A 2 QZ UU C0 M +1200L P M -II

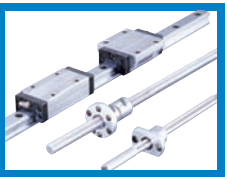
- HSR25: Model number
- A: Type of LM block
- 2: No. of LM blocks used on the same rail
- QZ: With QZ Lubricator
- UU: Contamination Protection Option
- C0: Radial clearance symbol
- M: Stainless steel LM block
- +1200L: LM rail length (in mm)
- P: Accuracy symbol
- M: Stainless steel LM rail
- -II: Symbol for No. of rails used on the same plane

Surface Treatment

The surfaces of the rails and shafts of LM systems can be treated for anti-corrosive or aesthetic purposes.
THK offers THK-AP treatment, which is the optimum surface treatment for LM systems.
The THK-AP treatment consists of the following 3 types.

AP-HC

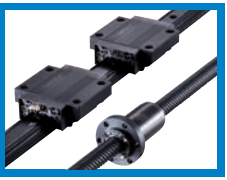
●Surface treatment···industrial-use hard chrome plating
●Film hardness···750 HV or higher



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

AP-C

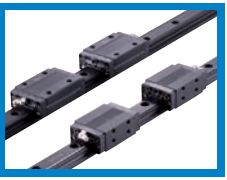
●Surface treatment···industrial-use black chrome coating



A type of industrial-use black chrome coating designed to increase corrosion resistance. It achieves lower cost and higher corrosion resistance than martensite 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 treatments, other surface treatments are sometimes performed on areas other than the raceways, such as alkaline coloring treatment (black oxidizing) and color anodize treatment. However, some of them are not suitable for LM systems. 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

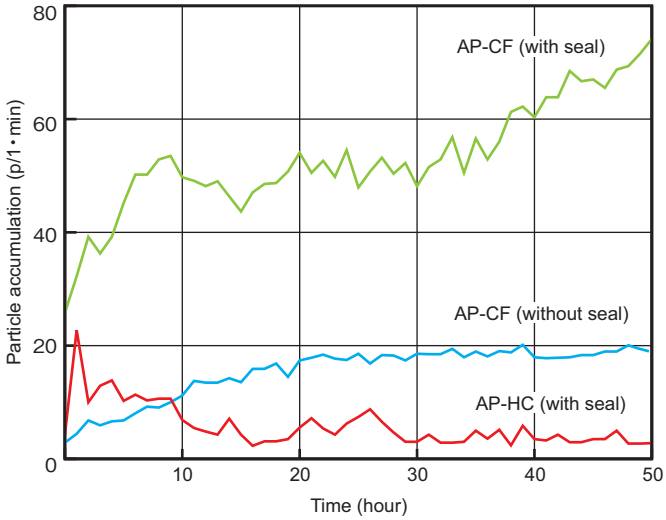
- SR15: Model number
- V: Type of LM block
- 2: No. of LM blocks used on the same rail
- F: With surface treatment on the LM block
- 640L: LM rail length (in mm)
- F: With surface treatment on the LM block

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 quantity	1cc (per LM block)
Speed	30m/min(MAX)
Stroke	200mm
Flow rate during measurement	1ℓ/min
Clean room volume	1.7 liter (acrylic casing)
Measuring instrument	Dust counter
Measured particle diameter	0.3μm 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 hours, drying for 6 hours
Temperature conditions	35℃ during spraying
	60℃ during drying

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

Contamination Protection

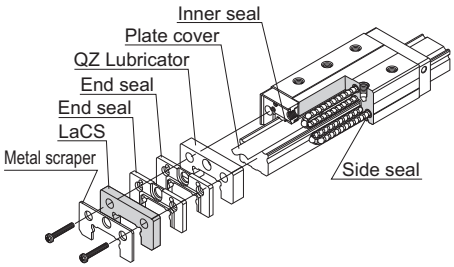
Contamination protection is the most important factor in using an LM system. Entrance of dust or other foreign material into the LM system will cause abnormal wear or shorten the service life. Therefore, when entrance of dust or other foreign material is a possibility, it is necessary to select a sealing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

(1) Dedicated seals for LM systems

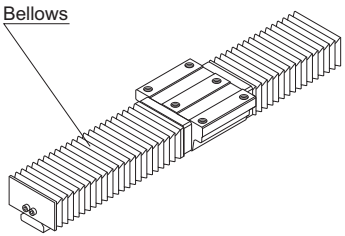
For LM systems, seals made of special synthetic rubber with high wear resistance (e.g., Laminated Contact Scraper LaCS) and a wiper ring are available as contamination protection seals.
For locations with severe condition environments, dedicated bellows and dedicated covers are available for some models.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

(2) Dedicated bellows

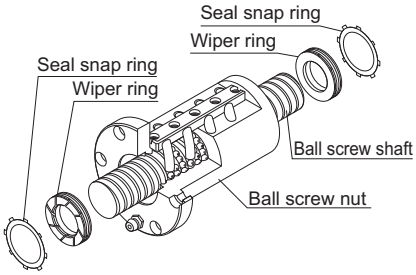
For LM Guides, standardized bellows are available.
THK manufactures dedicated bellows also for other LM systems such as Ball Screws and Ball Splines. Contact THK for details.



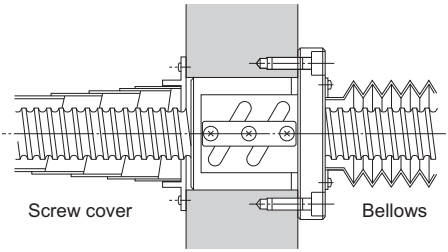
Contamination Protection Seals for the LM Guide



Dedicated Bellows for the LM Guide



Wiper Ring for the Ball Screw



Contamination Protection Cover for the Ball Screw