



LM Roller

THK General Catalog

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Features of the LM Roller

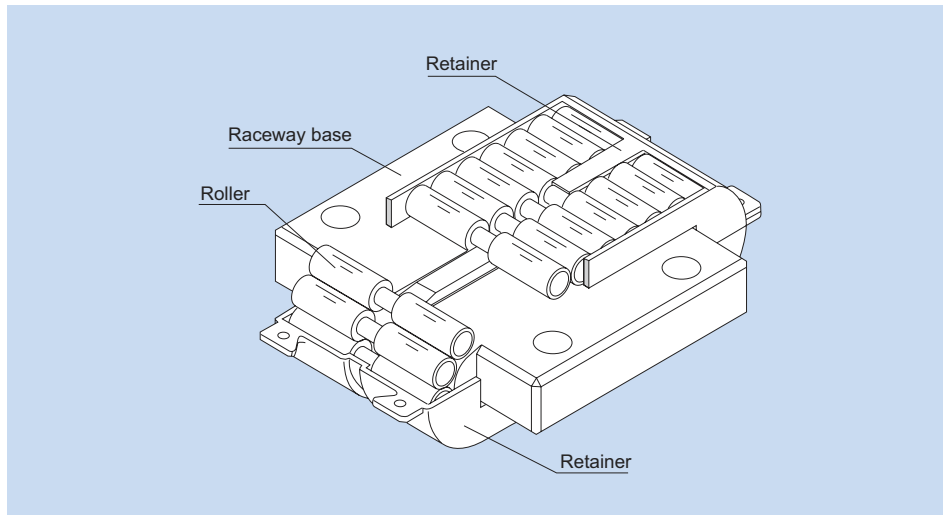


Fig.1 Structure of LM Roller Model LR

Structure and Features

In the LM Roller, dual rollers assembled on the circumference of the precision-ground, rigid raceway base travel in infinite circulation while being held by a retainer. A center guide integrated with the raceway base is formed in the central part of the loaded area of the raceway base to constantly correct skewing of the rollers. This unique structure ensures smooth rolling motion. The LM Roller is used in applications such as the XYZ guide of NC machine tools, precision press ram guides, press dies changers and heavy-load conveyance systems.

Features and Types

Features of the LM Roller

[Supports an Ultra Heavy Load and Ensures Smooth Motion]

The LM Roller is compact and capable of carrying a heavy load, and one unit of model LR50130 (length: 130 mm; width: 82 mm; height: 42 mm) is capable of receiving a 255 kN load. Moreover, because of rolling motion, this model has a low friction coefficient ($\mu = 0.005$ to 0.01) and is free from stick-slip, thus achieving highly accurate straight motion.


[High Combined Accuracy]

In general, when supporting a single plane with LM rollers, multiple units of LM rollers are combined on the same plane, and therefore, the height difference between the rollers significantly affects the machine accuracy and service life. With THK LM Roller, the user can select a combination of models with a height difference of up to $2 \mu\text{m}$.

[Rational Skewing-preventing Structure]

With an LM system using rollers, once the rollers skew, it increases friction resistance or decreases running accuracy.

To prevent skewing, the LM Roller has roller guides on the center of the retainer full circle, and in the center of the loaded area on the raceway base. This structure enables the LM Roller to automatically correct skewing caused by a mounting accuracy error and the rollers to travel in an orderly manner. It also allows the LM Roller to be installed with slant mount or wall mount while demonstrating high performance.



LM Roller

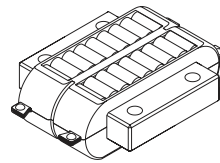
Types of the LM Roller

Types and Features

Model LR

This model is designed to be fit into a groove machined on the mounting surface. By screwing bolts into four holes on the raceway base, it is secured on the mounting surface. (Fixture models SM and SE are also available.)

[Specification Table⇒B-524](#)

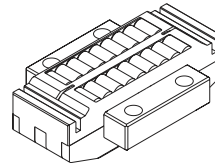


Model LR

Model LR-Z

A lighter type that uses a resin retainer and is designed to be mounted in the same manner as model LR. Since it has a groove for installing a seal, a special rubber seal with a high contamination protection effect can easily be attached. In addition, this model is capable of high-speed traveling at 1 m/s.

[Specification Table⇒B-524](#)

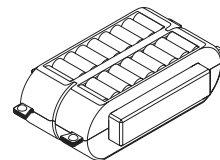


Model LR-Z

Model LRA

Just like model LR, this model is also designed to be fit into a groove. It is a compact type that can be mounted using fixture model SM or SE and bolts.

[Specification Table⇒B-525](#)

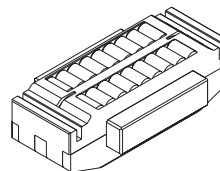


Model LRA

Model LRA-Z

A lighter type that uses a resin retainer and is designed to be mounted in the same manner as model LRA. Since it has a groove for installing a seal, a special rubber seal with a high contamination protection effect can easily be attached. In addition, this model is capable of high-speed traveling at 1 m/s.

[Specification Table⇒B-525](#)

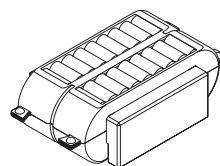


Model LRA-Z

Model LRB

Since this model does not require a groove on the mounting surface, man-hours for machining can be reduced. It can be mounted using fixture model SMB or SE and bolts.

Specification Table⇒B-526

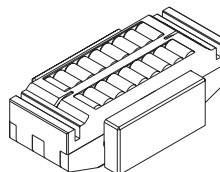


Model LRB

Model LRB-Z

A lighter type that uses a resin retainer and is designed to be mounted in the same manner as model LRB. Since it has a groove for installing a seal, a special rubber seal with a high contamination protection effect can easily be attached. In addition, this model is capable of high-speed traveling at 1 m/s.

Specification Table⇒B-526

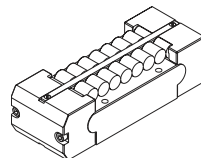


Model LRB-Z

Model LRU

Since this model does not require a groove on the mounting surface, man-hours for machining can be reduced. By screwing bolts into four holes on the raceway base, it is secured on the mounting surface.

Specification Table⇒B-527



Model LRU

Nominal Life

[Static Safety Factor f_s]

The LM Roller 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.

$$f_s = \frac{f_c \cdot C_0}{P_c}$$

f_s : Static safety factor

f_c : Contact factor

(see Table2 on A-610)

C_0 : Basic static load rating (kN)

P_c : Calculated load (kN)

● Reference Value of Static Safety Factor

The static safety factors indicated in Table1 are the lower limits of reference values in the respective conditions.

Table1 Reference Value of Static Safety Factors (f_s)

Machine using the LM system	Basic dynamic load rating	Lower limit of f_s
General industrial machinery	Without vibration or impact	1 to 1.3
	With vibration or impact	2 to 3
Machine tool	Without vibration or impact	1 to 1.5
	With vibration or impact	2.5 to 7

Point of Selection

Nominal Life

[Nominal Life]

The nominal life of the LM Roller is obtained using the basic dynamic load rating (C) indicated in the corresponding specification table, and the following equation.

$$L = \left(\frac{f_H \cdot f_c \cdot f_T}{f_w} \cdot \frac{C}{P_c} \right)^{\frac{10}{3}} \times 100$$

- L : Nominal life (km)
 (The total number of revolutions that 90% of a group of identical LM Roller units independently operating under the same conditions can achieve without showing flaking)
- C : Basic dynamic load rating (kN)
- P_c : Calculated radial load (kN)
- f_H : Hardness factor (see Fig.1)
- f_T : Temperature factor
 (see Fig.2 on A-610)
- f_c : Contact factor
 (see Table2 on A-610)
- f_w : Load factor (see Table3 on A-610)

[Calculating the Service Life Time]

When the nominal life (L) has been obtained, if the stroke length and the number of reciprocations per minute are constant, the service life time is obtained using the following equation.

$$L_h = \frac{L \times 10^6}{2 \times l_s \times n_1 \times 60}$$

- L_h : Service life time (h)
- l_s : Stroke length (mm)
- n₁ : Number of reciprocations per minute (min⁻¹)

● f_H: Hardness Factor

To maximize the load capacity of the LM system, the hardness of the raceways needs to be between 58 to 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).

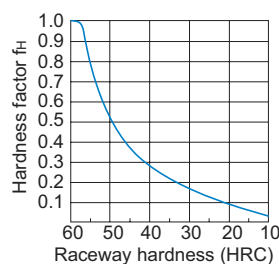


Fig.1 Hardness Factor (f_H)

● **f_t: Temperature Factor**

If the temperature of the environment surrounding the operating LM Roller exceeds 100°C, take into account the adverse effect of the high temperature and multiply the basic load ratings by the temperature factor indicated in Fig.2.

Note) The normal service temperature of the LM Roller is 80°C at a maximum. If the ambient temperature exceeds 80°C, contact THK.

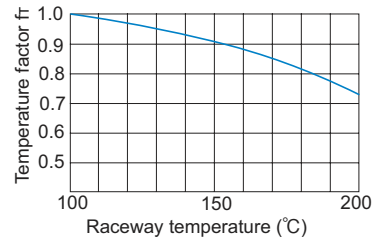


Fig.2 Temperature Factor (f_t)

● **f_c: Contact Factor**

When multiple LM Roller units are used in near close contact with each other, their linear motion is affected by moments and mounting accuracy, making it difficult to achieve uniform load distribution. In such applications, multiply the basic load rating (C) and (C₀) by the corresponding contact factor 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 LM Roller units in close contact with each other	Contact factor f _c
2	0.81
3	0.72
4	0.66
5	0.61
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, when the actual load applied to the LM Roller cannot be obtained, or when speed and impact have a significant influence, divide the basic load rating (C or C₀) by the corresponding load factor in Table3 of empirically obtained data.

Table3 Load Factor (f_w)

Vibrations/ impact	Speed(V)	f _w
Faint	Very low V ≤ 0.25m/s	1 to 1.2
Weak	Slow 0.25 < V ≤ 1m/s	1.2 to 1.5
Medium	Medium 1 < V ≤ 2m/s	1.5 to 2
Strong	High V > 2m/s	2 to 3.5

Accuracy Standards

When multiple LM Roller units are arranged on the same plane, the mounting heights of the LM Roller units must be identical in order to achieve uniform load distribution. The dimensional tolerance of the LM Roller in height (A) is defined as indicated in Table4. When ordering LM Roller units to be used on the same plane, specify their tolerances with the same classification symbol.

Each classification symbol is marked on the package box and on the side face of the LM Roller's raceway base as indicated in Fig.4. (except for normal grade)

Table4 Classification of Dimensional Tolerances in Height (A)
Unit: μm

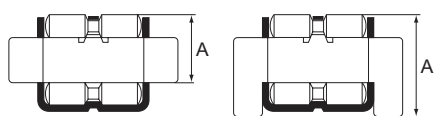
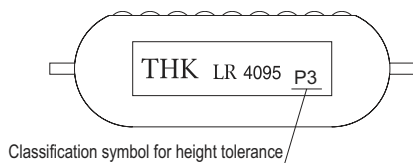


Fig.3 Mounting Height (A) of the LM Roller



Classification symbol for height tolerance

Fig.4

Accuracy Grades	Dimensional tolerance for A	Classification symbol
Normal grade	0 to -10	No Symbol
High grade	0 to -5	H5
	-5 to -10	H10
Precision grade	0 to -3	P3
	-3 to -6	P6
	-6 to -9	P9
	-9 to -12	P12
Ultra-precision grade	0 to -2	SP2
	-2 to -4	SP4
	-4 to -6	SP6
	-6 to -8	SP8
	-8 to -10	SP10

Raceway

To maximize the performance of the LM Roller, it is necessary to take into account the hardness, surface roughness and accuracy of the raceway, on which the rollers directly roll, when manufacturing the product. In particular, the hardness significantly affects the service life. Therefore, it is important to take much care in selecting a material and heat treatment method.

[Hardness]

We recommend surface hardness of 58 HRC (\approx 653 HV) or higher. The depth of the hardened layer is determined by the size of the LM Roller; we recommend approximately 2 mm for general use. If the hardness of the raceway is lower or the raceway cannot be hardened, multiply the load rating by the corresponding hardness factor (see Fig.1 on A-609).

[Material]

The following materials are generally used as suitable for surface hardening through induction-hardening and flame quenching.

- SUJ2 (JIS G 4805: high-carbon chromium bearing steel)
- SK3 to 6 (JIS G 4401: carbon tool steel)
- S55C (JIS G 4051: carbon steel for machine structural use)

If the machine body is a mold, depending on the conditions, a hardened steel plate may not be used and instead, the surface of mold itself may be hardened.

[Surface Roughness]

To achieve smooth motion, the surface should preferably be finished to 0.40a or less. If slight wear is allowed in the initial stage, the surface may be finished to approximately 0.80a.

[Accuracy]

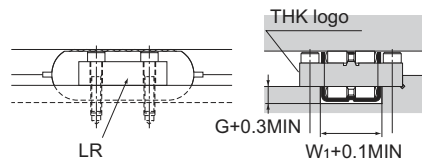
When high accuracy is required, securing a hardened steel plate to the machine body may cause undulation on the raceway. To avoid this, secure the LM Roller with bolts before grinding the hardened steel plate as with when mounting the product, or tightening it to the machine body before grinding and finishing the raceway, to produce a good result.

Installing the LM Roller

Fig.1 shows examples of installing the LM Roller. To minimize the gradient of the LM Roller in the traveling direction, provide a reference surface on the mounting surface and press the LM Roller toward it. The mounting reference surface of the LM Roller is opposite of the THK logo marked on the raceway base.

(a) Installing models LR, LRU and LR-Z

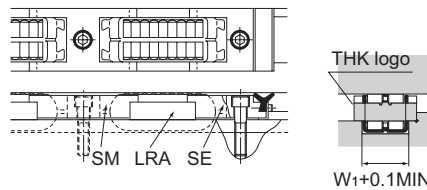
Use the four mounting bolt holes on the raceway base to mount the LM Roller.



For G and W₁, see the specification table.

(b) Installing models LRA and LRA-Z

The LM Roller can easily be secured using fixture model SM or SE. SE is provided with a wiper to increase contamination protection effect.



For W₁, see the specification table.

(c) Installing models LRB and LRB-Z

The LM Roller can easily be secured using fixture model SMB or SEB. SEB is provided with a wiper to increase contamination protection effect.

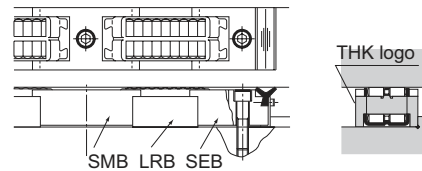


Fig.1 Installing the LM Roller

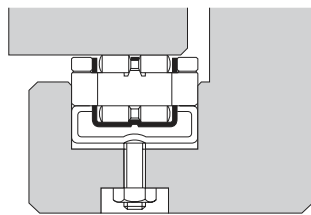
LM Roller

Guidance for Adjusting the Clearance

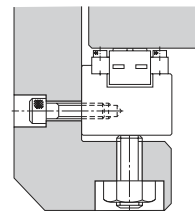
To secure stable accuracy during operation, the LM Roller is provided with a light preload. Provision of a preload is especially effective also in increasing the service life for applications where a vibration impact load or overhang load is applied.

Fig.2 shows clearance adjusting methods that are commonly practiced.

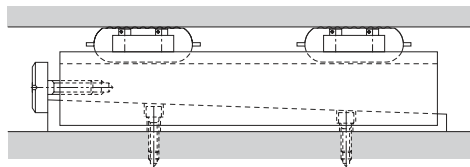
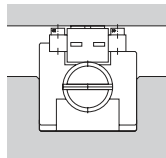
Normally, it is preferable to provide a preload that is approximately 3% of the basic dynamic load rating (C). Providing a preload to the LM Roller will stabilize the accuracy.



(a) Using a dedicated stopper



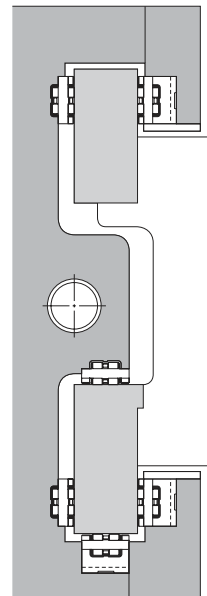
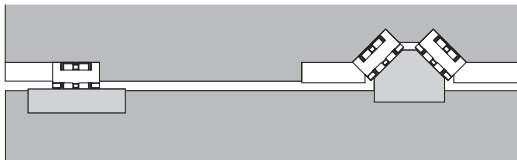
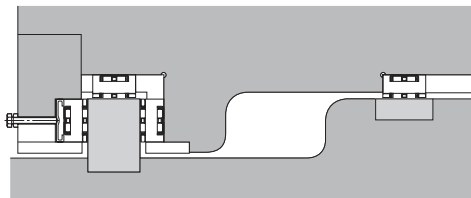
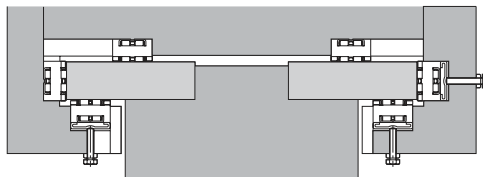
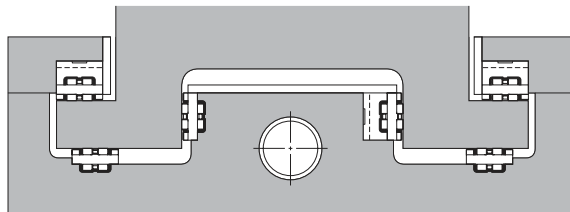
(b) Using a set screw



(c) Adjusting a tapered gib

Fig.2 Methods for Adjusting the Clearance of the LM Roller

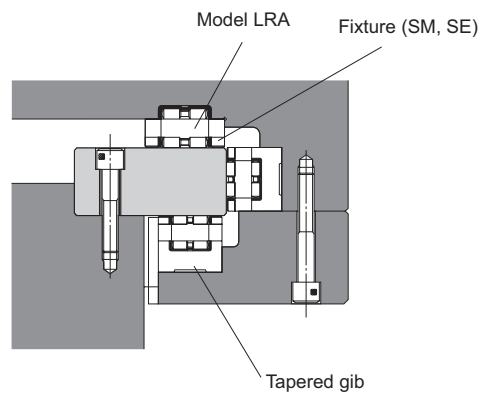
Examples of Arranging LM Roller Units



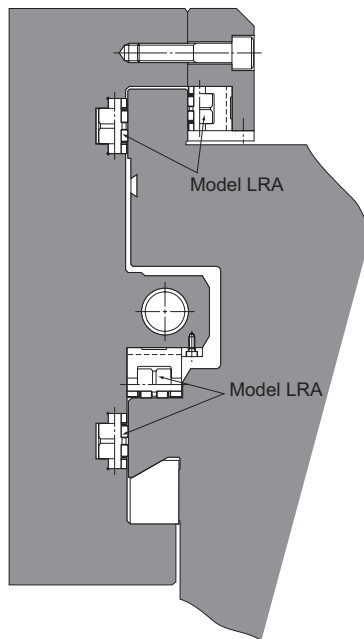
LM Roller

Examples of Installing the LM Roller

Assembling the slide section




Using the cross rail of a vertical lathe



Spring Pad Model PA

● For detailed dimensions, see B-528.

Item name	Schematic diagram / mounting location	Purpose/location of use
Spring Pad Model PA		By attaching this spring pad to the back of the LM Roller as shown in Fig.2 (a) on A-614 . Turning the adjustment bolt, adjustment of a clearance and a preload can easily be done.

[Guidance for Using the Spring Pad]

Spring pad model PA is a low price item that enables easy adjustment and achieves self-aligning. A preload can easily be adjusted by installing the spring pad to the machine and externally tightening the adjustment bolt using a torque wrench. As a result, the need for troublesome shim adjustment and machining for matching is eliminated.

● Example of Using the Spring Pad

- (1) When using the spring pad in the opposite position to provide a preload

To prevent the table from lifting or guiding it horizontally, using the spring pad on one side as shown in Fig.1 will easily provide a preload and eliminate vibrations and play of the machine.

- (2) When applying both sliding and rolling on the same plane

When desiring to increase friction resistance because the table inertia is large, or desiring to increase rigidity under a heavy load, the spring pad can be used in combination with the sliding surface. To do so, install the LM Roller and the spring pad to several locations on the table as shown in Fig.2, and then tighten the adjustment bolt by the load to be allocated to the LM Roller.

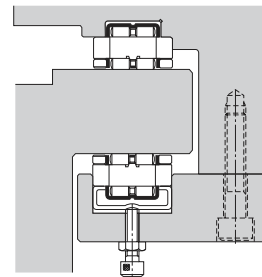


Fig.1

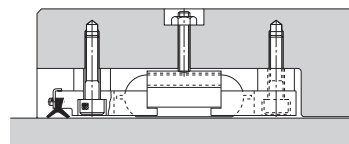


Fig.2

● **Guidance for Installing the Spring Pad**

Fig.3 shows examples of installing the spring pad model PA to the bottom of the LM Roller and adjusting the clearance and providing a preload.

The dimensions in this example are indicated in the specification table for the spring pad model PA. The following is the procedure for the installation.

- (1) Secure the fixture and the spacer. Adjust them so that the LM Roller can move vertically.
- (2) Turn the adjustment bolt until the LM Roller hits the raceway.
- (3) Turn the adjustment bolt using a torque wrench and tighten it until the desired torque is reached. A preload is provided via the spring pad model PA.

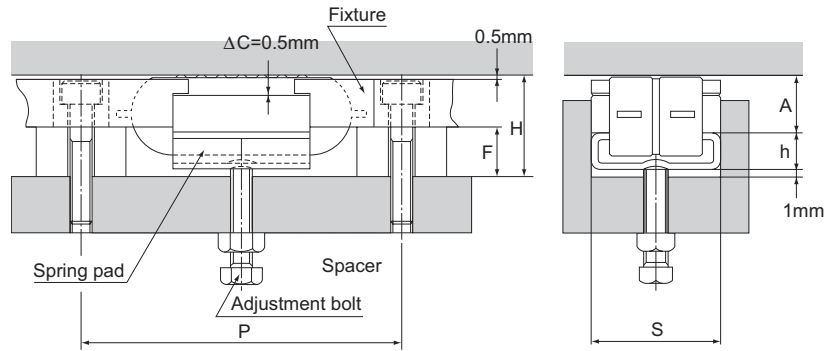
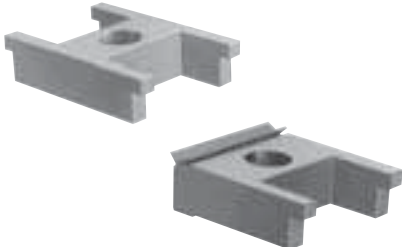


Fig.3

Fixture Models SM/SMB and SE/SEB

● For detailed dimensions, see B-529.

Item name	Schematic diagram / mounting location	Purpose/location of use
<p>Fixture Models SM/SMB and SE/SEB</p>		<p>Use of fixture model SM or SE eliminates the need to machine thin tapped holes for mounting the LM Roller, and allows the roller to firmly be secured. Models SE and SEB each have a special rubber wiper with double lips to achieve a high contamination protection effect.</p>

[Handling]

- (1) Disassembling components may cause dust to enter the system or degrade mounting accuracy of parts. Do not disassemble the product.
- (2) Dropping or hitting the LM Roller may damage it. Giving an impact to the product could also cause damage to its function even if the product looks intact.

[Contamination Protection and Lubrication]

With the LM Roller, once foreign material enters the raceway due to poor contamination protection, it cannot be removed easily and tends to severely damage the raceway or the LM rollers. Therefore, use much care in contamination protection.

Fixture for the LM Roller models SE and SEB each have a special rubber wiper with double lips to achieve a high contamination protection effect. Feeding grease between the double lips when attaching the fixture, as shown in Fig.1, will further increase the effect.

For locations subject to cutting chips or welding spatter, it is necessary to use a contamination protection cover such as a bellows and a telescopic cover, or a wiper reinforced with a metal plate as indicated in Fig.2.

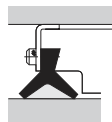


Fig.1 Wiper of Fixture Models SE and SEB

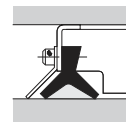


Fig.2 Reinforced Wiper

For contamination protection of the side faces, items as shown in Fig.3 are available.

The required quantity of lubricant is much smaller than sliding guides, making the lubrication control easy.

As for the lubricant, the same type of grease or lubricant as that of ordinary bearings will be adequately effective. To achieve a high level of grease retention, it is preferable to use lithium-soap group grease No. 1 or 2, or slightly viscous sliding surface oil or turbine oil.

To replenish the lubricant to the LM Roller, drop the lubricant from the greasing hole provided on the back of the retainer as necessary, or directly drop it to the raceway. If the LM Roller is not used frequently, it is also possible to apply grease to the rollers of the product.

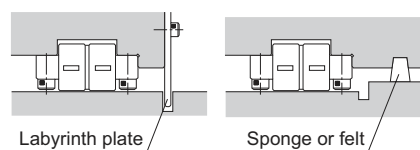


Fig.3

[Mounting Reference Surface]

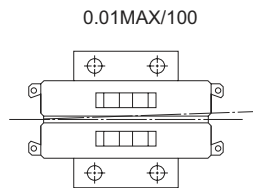
To help correctly mount the LM Roller in the traveling direction, it has a mounting reference surface on the side face of the raceway base. The reference surface is on the opposite side of the THK logo.

[Mounting Precision]

To maximize the performance of the LM Roller, it is necessary to distribute the load as evenly as possible when mounting the product. For the parallelism between the roller and the raceway indicated in Fig.4, we recommend 0.015 mm or less against 100 mm. For the allowable tilt of the roller in the longitudinal direction, 0.01 mm or less against 100 mm is recommended.



(a) Parallelism between the LM Roller and the raceway (b) Allowable tilt of the roller in the longitudinal direction



(c) Parallelism between the LM Roller and the raceway in the horizontal direction

Fig.4 LM Roller and Mounting Precision

[Precautions on Use]

- (1) If foreign material adheres to the product, replenish the lubricant after cleaning the product.
- (2) Do not use the resin retainer for LM Roller model LR (A, B)-Z and seals (including SE and SEB) in an environment at temperature of 80°C or higher.
- (3) When using the product in locations exposed to constant vibrations or in special environments such as clean rooms, vacuum and low/high temperature, contact THK in advance.

[Storage]

When storing the LM Roller, enclose it in a package designated by THK and store it while avoiding high temperature, low temperature and high humidity.