THK

*ISO-standard

THK GLOBAL STANDARD

NEW

Press Fit Type Linear Bushing **LMHB**

Simple installation through press fitting
An original design with silent, clearance-free motion
Conforms to ISO 10285 Series 1

NEW Press Fit Type Linear Bushing

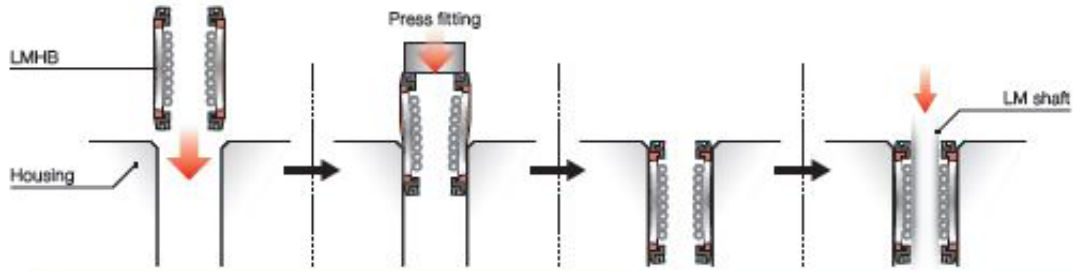
LMHB

The LMHB is a linear bushing that is press-fit into a housing.
It achieves smooth, silent motion thanks to the spring effect provided by the proprietary curved metal plates designed by THK.

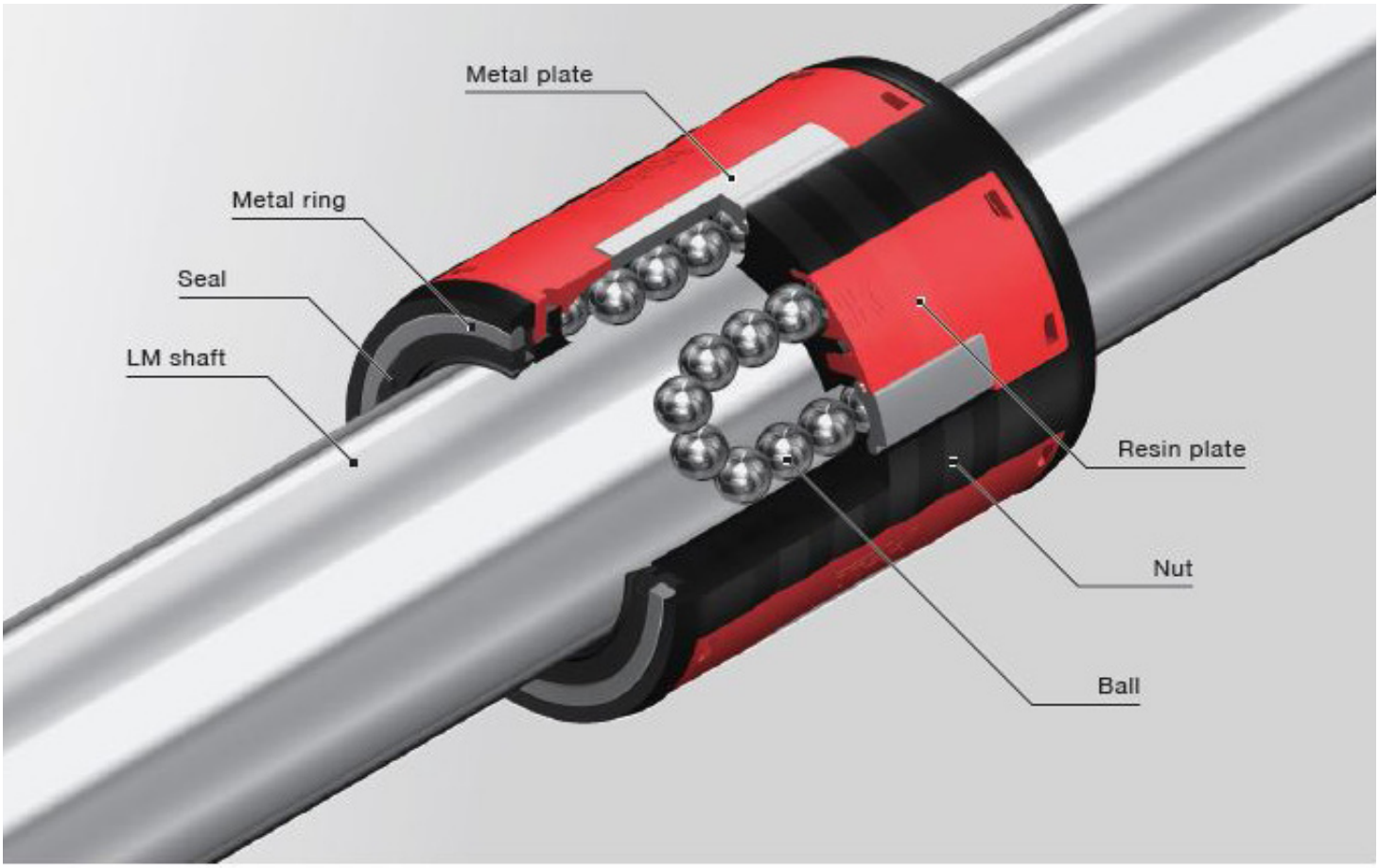
* The LMHB's clearance is set by the combination of housing and LM shaft.
See "Operating Clearance" on page 6 for details.

Feature 1 Easy to Install

Unlike with a metal linear bushing, the nut of the LMHB is **press-fit into a housing**.
Using an LMHB makes it possible to **automate installation and boost productivity by reducing installation time.**

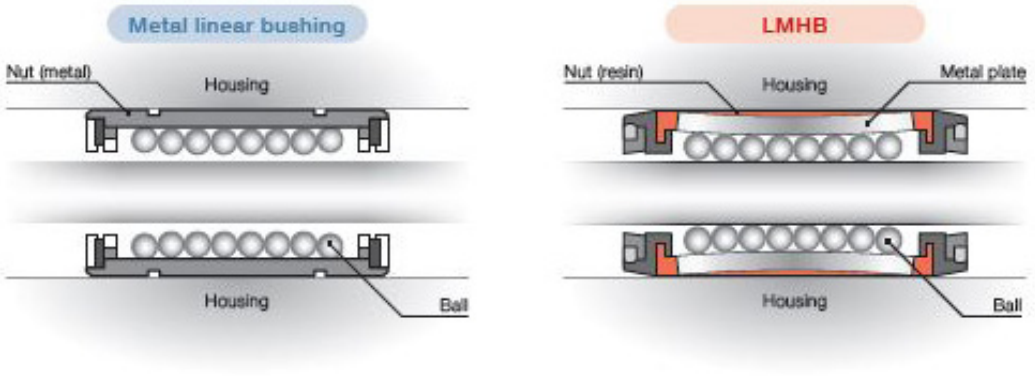


Installation process	Common methods for fastening a metal linear bushing	Using press fitting to fasten an LMHB
	● Fastening with a snap ring ● Fastening with a stop plate Requires additional machining on the housing and manual handling of small parts	● Fastening with a press Installation does not require any small parts



Feature 2 Silent and Clearance-Free

The LMHB achieves **smooth, silent motion** thanks to the spring effect provided by the proprietary curved metal plates designed by THK, which **minimize clearance** between the balls and LM shaft.

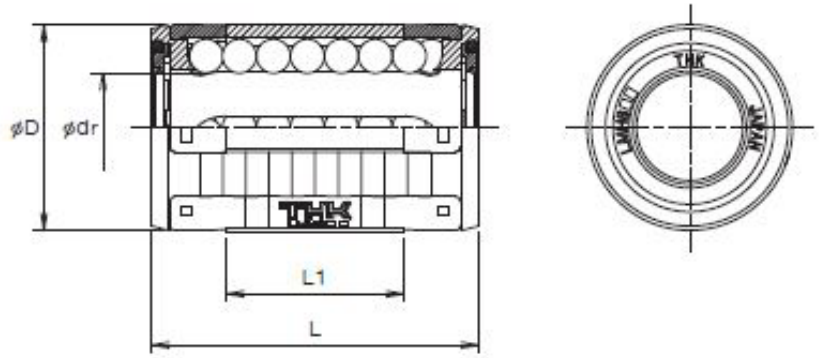


Feature 3 Thin, Compact, ISO-Standard Design

The LMHB conforms to ISO 10285 Series 1, and it allows for more compact machine designs.

Specification Table

LMHB



Model	Ball rows	Inscribed bore diameter[1]		Outer diameter		
		dr	Tolerance	D		
LMHB 8S	4	8	0 −0.009	15		
LMHB 8	4	8		15		
LMHB 10	5	10		17		
LMHB 12	5	12		19		
LMHB 14	5	14		21		
LMHB 16	5	16		24		
LMHB 20	6	20	0 −0.010	28		

[1] The tolerance of the inscribed bore diameter is the value when press-fit to the lower limit of the recommended housing inner diameter (H7).
See "Housing Inner Diameter Dimensions and LM Shaft Outer Diameter Dimensions" on page 5 for details.
The inscribed bore diameter will change based on the the inner diameter of the housing.
The tolerance of the inscribed bore diameter does not include the curvature of the metal plates.

Model Number Coding

Select an option.

LMHB8 M UU

- LMHB8 — Model series
- M — Ball material
  - No symbol: SUJ2
  - M: SUS440C
- UU — Seal symbol
  - No symbol: Without seal
  - UU: Seal attached on both sides

Unit: mm

		Overall length		Metal plate length	Basic load rating		Weight (g)
		L	Tolerance	L1	C (N)	C_0 (N)	
		17	±0.2	7.5	432	211	5.3
		24		13	619	352	7.6
		26		13	730	409	9.6
		28		15.4	868	509	12.1
		28		15.4	897	522	12.8
		30		15.4	1162	621	17.8
		30		15.4	1462	786	21.7

Pol. Ind. Can Vinyalets. C/ Can Vinyalets, Núm. 9 Nau 6 • 08130 Santa Perpètua de la Mogoda (Barcelona)
934 45 77 77 • clientes@daneel-mechatronics.com

Installation

Housing Inner Diameter Dimensions and LM Shaft Outer Diameter Dimensions

The following table shows the dimensions of typical housings and LM shafts combined with the LMHB. Only typical tolerances are listed in the table. See "Operating Clearance" on the next page for more combinations. The recommended tolerances for the LMHB are H7 for the housing inner diameter and h6 for the LM shaft outer diameter.

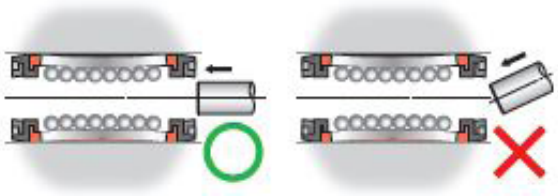
Unit: mm

Model	Housing				LM shaft	
	Inner diameter	+ Clearance -			Outer diameter	Tolerance h6 (recommended)
		Tolerance H7 (recommended)	Tolerance J7	Tolerance K7		
LMHB 8S	15	+0.018 0	+0.010 -0.008	+0.006 -0.012	8	0 -0.009
LMHB 8	15				8	
LMHB 10	17				10	
LMHB 12	19	+0.021 0	+0.012 -0.009	+0.006 -0.015	12	0 -0.011
LMHB 14	21				14	
LMHB 16	24				16	
LMHB 20	28				20	0 -0.013

* The LMHB is designed to exhibit its true performance with the housing and shaft combinations given in the above table. Please select a housing and shaft combination that is listed in the above table or under "Operating Clearance" on the next page.

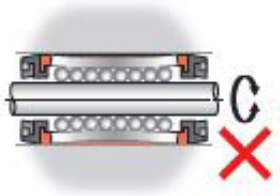
LM Shaft Insertion

Inserting an LM shaft into the LMHB will cause balls to fall out if the shaft is forced in at an angle, so make sure it is centered and insert it gently.



Rotary Use Prohibited

The design of the LMHB is not suited for rotary motion. Please be aware that forcing it to rotate may cause an unexpected accident.



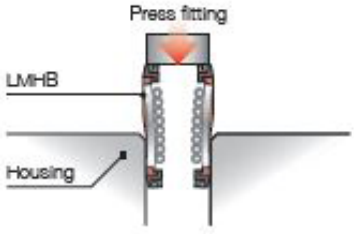
Moment Loads

Make sure that loads are distributed evenly along the entire length of the ball raceways when using the LMHB. In particular, if a moment load will be applied, use two or more LMHB units per LM shaft and space them as far apart as possible when installing. Additionally, calculate the equivalent radial load if a moment load will be applied and then confirm the model to be used.

Press Fitting

The LMHB is installed by being press-fit into a housing, so use a hand press or other device to gently insert the entire end face of the nut in a uniform fashion. Using a hammer to strike the end face of the nut may damage the end face.
Please also provide chamfering around the opening of the housing inner diameter to allow the LMHB to be pressed in smoothly.

* A snap ring, stop plate, or other fastener can be installed to further improve the pull-out strength of the housing.



Operating Clearance

See the following tables for the LMHB's operating clearance (the actual clearance based on the combination of the housing and LM shaft tolerances).

Model	H6	
	MAX	MIN
LMHB 8S/8	17	−9
	12	−4

Upper row = Entire range Encompasses values from all combinations, including the maximum permissible housing dimensions and minimum permissible LM shaft dimensions.

Bottom row = 3σ Encompasses typical housing and LM shaft combinations within permissible dimensions. Represents 99.7% of all values.

LM shaft external diameter tolerance: h5

Unit: µm

Model	Inscribed bore diameter			Housing inner diameter tolerance											
				H6		J6		K6		H7		J7		K7	
	Nominal value (mm)	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.
LMHB 8S/8	8	0	-9	17	-9	12	-14	8	-18	24	-9	16	-17	12	-21
				12	-4	7	-9	3	-13	19	-4	11	-12	7	-16
LMHB 10	10	0	-9	17	-9	12	-14	8	-18	24	-9	16	-17	12	-21
				12	-4	7	-9	3	-13	19	-4	11	-12	7	-16
LMHB 12	12	0	-9	21	-9	16	-14	10	-20	29	-9	20	-18	14	-24
				15	-3	10	-8	4	-14	22	-2	13	-11	7	-17
LMHB 14	14	0	-9	21	-9	16	-14	10	-20	29	-9	20	-18	14	-24
				15	-3	10	-8	4	-14	22	-2	13	-11	7	-17
LMHB 16	16	0	-9	21	-9	16	-14	10	-20	29	-9	20	-18	14	-24
				15	-3	10	-8	4	-14	22	-2	13	-11	7	-17
LMHB 20	20	0	-10	22	-10	17	-15	11	-21	30	-10	21	-19	15	-25
				15	-3	10	-8	4	-14	22	-2	13	-11	7	-17

LM shaft external diameter tolerance: h6

Unit: µm

Model	Inscribed bore diameter			Housing inner diameter tolerance											
				H6		J6		K6		H7		J7		K7	
	Nominal value (mm)	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.
LMHB 8S/8	8	0	-9	20	-9	15	-14	11	-18	27	-9	19	-17	15	-21
				14	-3	9	-8	5	-12	20	-2	12	-10	8	-14
LMHB 10	10	0	-9	20	-9	15	-14	11	-18	27	-9	19	-17	15	-21
				14	-3	9	-8	5	-12	20	-2	12	-10	8	-14
LMHB 12	12	0	-9	24	-9	19	-14	13	-20	32	-9	23	-18	17	-24
				18	-3	13	-8	7	-14	25	-2	16	-11	10	-17
LMHB 14	14	0	-9	24	-9	19	-14	13	-20	32	-9	23	-18	17	-24
				18	-3	13	-8	7	-14	25	-2	16	-11	10	-17
LMHB 16	16	0	-9	24	-9	19	-14	13	-20	32	-9	23	-18	17	-24
				18	-3	13	-8	7	-14	25	-2	16	-11	10	-17
LMHB 20	20	0	-10	26	-10	21	-15	15	-21	34	-10	25	-19	19	-25
				18	-2	13	-7	7	-13	25	-1	16	-10	10	-16

LM shaft external diameter tolerance: h7

Unit: µm

Model	Inscribed bore diameter			Housing inner diameter tolerance											
				H6		J6		K6		H7		J7		K7	
	Nominal value (mm)	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.
LMHB 8S/8	8	0	-9	26	-9	21	-14	17	-18	33	-9	25	-17	21	-21
				19	-2	14	-7	10	-11	25	-1	17	-9	13	-13
LMHB 10	10	0	-9	26	-9	21	-14	17	-18	33	-9	25	-17	21	-21
				19	-2	14	-7	10	-11	25	-1	17	-9	13	-13
LMHB 12	12	0	-9	31	-9	26	-14	20	-20	39	-9	30	-18	24	-24
				23	-1	18	-6	12	-12	30	0	21	-9	15	-15
LMHB 14	14	0	-9	31	-9	26	-14	20	-20	39	-9	30	-18	24	-24
				23	-1	18	-6	12	-12	30	0	21	-9	15	-15
LMHB 16	16	0	-9	31	-9	26	-14	20	-20	39	-9	30	-18	24	-24
				23	-1	18	-6	12	-12	30	0	21	-9	15	-15
LMHB 20	20	0	-10	34	-10	29	-15	23	-21	42	-10	33	-19	27	-25
				25	-1	20	-6	14	-12	32	0	23	-9	17	-15

* The inscribed bore diameter is the value when press-fit into a housing that is ±0 with respect to the nominal value.
* Contact THK about any LM shaft outer diameter tolerances not listed in the above tables.

Material

For both its metal plates and metal ring, the LMHB uses stainless steel, which has high corrosion resistance.
Balls are available in either carbon steel or stainless steel.

* The standard specification for balls is carbon steel.

Lubrication

The LMHB can be lubricated with grease or oil.

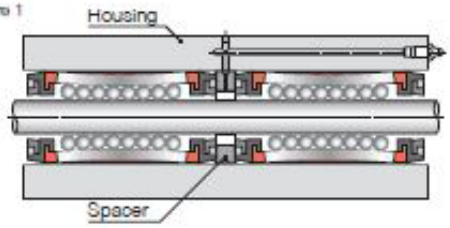
Grease Lubrication

Apply grease to the LMHB's ball rows before inserting the LM shaft and using the product.
After that, depending on how the product is used, either apply grease with this method at appropriate intervals, provide a housing such as that shown in Figure 1, or apply grease to the LM shaft.

Oil Lubrication

Either drip oil on the LM shaft at appropriate intervals or, as with grease lubrication, provide a housing such as that shown in Figure 1.
Typically, either turbine oil, machine oil, or spindle oil will be used.
In addition to the above options, there are also ways to use oil holes or grease nipples. Please contact THK for details.

Figure 1



Recommended Grease

AFB-LF Grease is a general-purpose grease that provides excellent extreme pressure resistance and mechanical stability through the use of a refined mineral oil base oil and a lithium-based consistency enhancer.

* Other greases can also be used. Contact THK for details.

AFB-LF Representative Physical Properties

Item		Representative property	Testing method
Consistency enhancer		Lithium-based	
Base oil		Refined mineral oil	
Base oil kinematic viscosity: mm^2/s (40°C)		170	JIS K 2220 23
Worked penetration (25°C, 60 W)		275	JIS K 2220 7
Mixing stability (100,000 W)		345	JIS K 2220 15
Dropping point: °C		193	JIS K 2220 8
Evaporation volume: mass% (99°C, 22 h)		0.4	JIS K 2220 10
Oil separation rate: mass% (100°C, 24 h)		0.6	JIS K 2220 11
Copper plate corrosion (B method, 100°C, 24 h)		Passed	JIS K 2220 9
Low-temperature torque: mN·m (-20°C)	Starting	130	JIS K 2220 18
	Rotational	51	
4-ball testing (welding load): N		3089	ASTM D2596
Operating temperature range: °C		-15 to 100	
Color		Yellowish brown	

Load Rating and Nominal Life

Load Rating

The load rating of the LMHB varies based on the ball positions relative to the direction of the load. The basic load rating given in the specification table is the value when one row of load-bearing balls is positioned directly beneath the load.
If the product is installed so that two rows equally bear the load with respect to the direction of the load, the load rating will change as indicated in Table 1.

Table 1: LMHB Load Rating

Ball rows	Ball position	Ball rows
4		1.41 × C
5		1.46 × C
6		1.28 × C

C: See the specification table

Calculating the Nominal Life

THK defines the nominal life of the LMHB as 50 km. The nominal life (L_{10}) is calculated from the basic dynamic load rating (C) and the load acting on the LMHB (P_C) using the following formula.

$$L_{10} = \left(\frac{C}{P_C}\right)^3 \times 50$$

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

* This nominal life formula may not apply if the length of the stroke is less than or equal to twice the length of the nut.

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:

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

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

Calculating the Modified Nominal Life

During use, the LMHB 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 nuts arranged directly behind one another 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 formula.

•Modified factor α

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

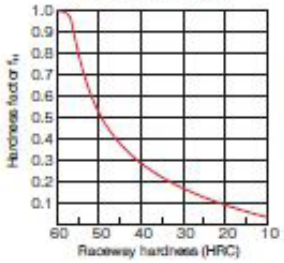
α: Modified factor
f_H: Hardness factor (See figure below)
f_T: Temperature factor (See figure below)
f_C: Contact factor (See table below)
f_W: Load factor (See table below)

•Modified nominal life L_{10m}

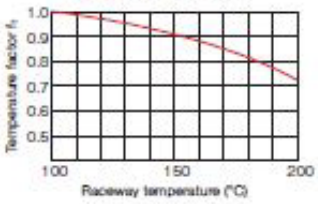
$$L_{10m} = \left(\alpha \times \frac{C}{P_C}\right)^3 \times 50$$

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

f_H: Hardness factor



f_T: Temperature factor



f_C: Contact factor

Nuts in close contact	Contact factor f_C
2	0.81
3	0.72
4	0.66
5	0.61
Normal use	1

f_W: Load factor

Vibration/ impacts	Speed (V)	f_W
Minute	Under minute speeds V ≤ 0.25 m/s	1 to 1.2
Low	Under low speeds 0.25 < V ≤ 1 m/s	1.2 to 1.5
Medium	Under medium speeds 1 < V ≤ 2 m/s	1.5 to 2
High	Under high speeds V > 2 m/s	2 to 3.5

•When a Moment Is Applied to One Nut or Two Nuts in Close Contact

When a moment is applied to a system with one nut or two nuts arranged directly behind one another, calculate the equivalent radial load when the moment is applied.

$$P_U = K \cdot M$$

P_U: Equivalent radial load (N) (Depends on moment load)
K: Equivalent factor (See table on right)
M: Applied moment (N·mm)
P_U must be less than the basic static load rating (P_0).

•When a Moment and Radial Load Are Simultaneously Applied

If a moment and radial load will be applied simultaneously, calculate the nominal life from the sum of the radial load and the equivalent radial load.

Equivalent Radial Factor

See the table below for the equivalent radial factor for the LMHB.

Model	Equivalent radial factor K	
	1 nut	2 nuts
LMHB 8S	0.72	0.19
LMHB 8	0.51	0.15
LMHB 10	0.51	0.13
LMHB 12	0.44	0.13
LMHB 14	0.44	0.13
LMHB 16	0.42	0.12
LMHB 20	0.42	0.12

Calculating the Service Life Time

Once the nominal life (L_{10}) has been obtained, the service life time can be obtained using the following formula if the stroke length and the cycles per minute are constant.

$$L_h = \frac{L_{10} \times 10^3}{2 \times \ell_s \times n_1 \times 60}$$

L_h: Service life time (h)
ℓ_s: Stroke length (mm)
n_1: Cycles per minute (min^{-1})

LM Shaft

The LMHB is a product used in combination with an LM shaft. THK manufactures high-quality LM shafts and will machine shaft ends according to customer requirements.

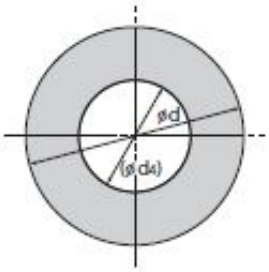
- **Primary materials**
  SUJ2 (High-carbon chrome bearing steel)
  THK5SP (THK standard material)
  SUS440C equivalent
- **Hardness**
  58 to 64 HRC (SUJ2 and THK5SP)
  56 HRC or above (SUS440C equivalent)
- **Depth of hardened layer**
  0.8 to 2.5 mm (depending on shaft diameter)
- **Surface roughness**
  Ra 0.4 or less
- **LM shaft straightness**
  60 µm/300 mm or less

Unit: mm

Model	Shaft diameter		Manufacturing length L	
	d	Tolerance h6 (µm)	Minimum length	Maximum length
SF 8	8	0 -9	20	1500
SF 10	10		30	1500
SF 12	12	0 -11	30	1500
SF 14	14		30	1500
SF 16	16		40	3000
SF 20	20	0 -13	40	3000

Hollow LM Shaft Dimensions

If a hollow LM shaft is required for purposes such as weight reduction, based on the model, THK provides material with the dimensions given in the table below.



Unit: mm

Applicable model	Outer diameter d	Inner diameter (d_4)	Weight (kg/m)	
			Hollow shaft	Solid shaft
LMHB 8S/8	8	3	0.34	0.4
LMHB 10	10	4	0.52	0.62
LMHB 12	12	6	0.67	0.89
LMHB 16	16	9	1.09	1.59
LMHB 20	20	10	1.86	2.47
LMHB 20	20	14	1.26	2.47

* Please contact THK about outer diameter ø14.

Model Number Coding

Select an option.

SF20 h6 -500L M

- SF20: Model series
- h6: LM shaft outer diameter tolerance
- -500L: LM shaft overall length (mm)
- M: Special symbol*
  No symbol: Solid shaft
  K: Standard hollow shaft
  M: Special material
  F: Surface treatment
  * If adding multiple symbols, they must be put in alphabetical order.

Handling

(1) Do not disassemble this product. Doing so may cause the ingress of foreign materials and hinder the product's performance and the assembly accuracy of its components.
(2) Take care not to drop or strike this product. Otherwise, it may cause injury or damage the unit.
Even if there is no outward indication of damage, a sudden impact could prevent the unit from functioning properly.
(3) Wear appropriate safety gear, such as protective gloves and safety shoes, when handling the product.

Precautions on Use

(1) Prevent dust and other foreign materials from getting inside the product. Failure to do so could damage the product.
(2) Prevent foreign materials, such as cutting chips, coolant, corrosive solvents, or water from getting in the product by using a bellows or cover when the product is used in an environment where such a thing is likely.
(3) Do not use this product if the external temperature exceeds 70°C. If used above this temperature, there is a risk that the resin and rubber parts may deform or become damaged.
(4) If foreign materials such as dust adhere to the product, replenish the lubricant after washing the product.
(5) Very small strokes can inhibit the formation of an oil film between the raceways and the area of contact for the rolling elements, resulting in fretting.
Use a grease that is highly resistant to fretting. We recommend periodically allowing the nut to stroke a distance roughly equal to its length to help ensure that a film forms between the raceways and rolling elements.
(6) Do not forcibly drive a pin, key, or any other positioning device into the product. This could cause the product to deform and experience a loss of function.
(7) Forcibly inserting a shaft into this product at an angle may cause the nut to deform and balls to fall out. Make sure that the shaft and nut are centered before gently inserting the shaft.
(8) Wipe off anti-rust oil and feed lubricant before using the product.
(9) For the LMHB 8S, use two or more bushings per shaft.
(10) If a moment load will be applied to this product, use two or more bushings per shaft and space them far apart when installing.
(11) Due to its internal structure, this product cannot perform rotary motion.
(12) Using this product while rolling elements are missing could lead to premature failure of the product.
(13) If any rolling elements fall out, contact THK. Do not use the product in that condition.
(14) If the mounting material lacks sufficient rigidity or accuracy, the bearing load may be focused in one area, and bearing functionality will dramatically decrease.
Therefore, give sufficient consideration to the rigidity and accuracy of the housing and base.

Lubrication

(1) Do not mix different lubricants. Even grease containing the same type of thickening agent may, if mixed, interact negatively due to disparate additives or other ingredients.
(2) When using the product in locations exposed to constant vibrations or in special environments such as in clean rooms, vacuums, and low/high temperatures, use a lubricant suitable for its use/environment.
(3) When lubricating the product, directly coat the raceways with lubricant and perform several warm-up strokes to ensure that the grease permeates the interior.
(4) Grease viscosity can vary depending on the temperature. Please keep in mind that the product's sliding resistance may be affected by changes in viscosity.
(5) After lubrication, the sliding resistance of the product may increase due to the stirring resistance of the grease.
Be sure to perform a warming-up operation and allow the grease to break in sufficiently before operating the equipment.
(6) Excess grease may spatter after lubrication. Wipe off spattered grease as necessary.
(7) Grease deteriorates over time, which decreases the lubricity, so perform regular grease inspections and replenish grease based on frequency of use.
(8) The greasing interval varies depending on the usage conditions and environment. The final greasing interval/amount should be set at the actual machine.

Storage

When storing the product, pack it as designated by THK and store it indoors away from high or low temperatures and high humidity.

Disposal

The product should be treated as industrial waste and disposed of appropriately.