MTK+ BEARINGS

Linear ball bushings

Linear ball bushings

Load rating

Basic dynamic load rating

This term is arrived at based on an evaluation of a number of identical linear systems individually run in the same conditions, if 90% of them can run with the load (with a constant value in a constant direction) for a distance of 50 km without damage caused by rolling fatigue. This is the basis of the rating.

Allowable static moment

This term defines the allowable limit value of static moment load, with reference to the amount of permanent deformation similar to that used for evalution of basic rated load (Co).

Static safety factor

This factor is used based on the application condition as shown in Table 1.

Basic static load rating

This term defines a static load such that, at the contacting position where the maximum stress is exercised , the sum of the permanent deformation of the rolling elements and that of the rolling plane is 0,0001 time of the diameter of the rolling elements.

Static safety factors

Table 1.

Condition of use	Low limit of fs
When the shaft has less deflection and shock	1 to 2
When elastic deformation should be considered whith respect to pinch load	2 to 4
When the equipment is subject to vibration and impacts	3 to 5

Rating Life

Rating life of the linear system

As long as linear system reciprocates while being loaded, continous stress acts on the linear system to couse flaking on the rolling bodies and planes because of material fatigue. The travelling distance of linear system until the fist flaking occurs is called the life of the system. The life of the dimensions, structure, material, heat treatment and processing method, when used in the same conditions. This variation is brought about from the essential variations in the material fatigue itself. The rating life defined bellow is used as an index for the life expectancy of the linear system.

Rating life

Rating life is the total travelling distance that 90% of a group of systems of the same size can reach without causing any flaking when they operate under the same conditions.

The rating life can be obtained from the following equation with the basic dynamic load rating and the load on the linear system:

For ball type:

$$L = \left(\frac{C}{P}\right)^3 50,$$

where:

L - rating life, km,

C - basic dynamic load rating, N,

P -load, N.

Consideration and influence of vibration impact loads and distribution of load should be taken into account when designing a linear motion system. It is difficult to calculate the actual load. The rating life is also affected by the operating temperature. In these conditions, the expression (1) is arranged as follows:

For ball type:

$$L = \left(\frac{f_H \times f_T \times f_C}{f_W \times P}\right)^3 \times 50,$$

where:
L -rating life, km,
f_H -hardness factor (see figure 1),
C -basic dynamic load rating, N,
f_T -temperatuer coefficient (see figure 2),
P -load, N,
f_C -contact coefficient (see table 2),
f_W -load coefficient (see table 3).

The rating life in hours can be calculated by obtaining the travelling distance per unit time. The rating life in hours can be obtained from the following expression when the stroke length and the number of strokes are constant:

$$L_h = \frac{L \times 10^3}{2\, l_s \times n_1 \times 60},$$

where:
L_h -rating life in hours, h_r,
l_s -stroke length, m,
L -rating life, km,
n_1 -no of strokes per minute, cpm.

Hardness factor

The shaft be sufficiently hardened when a linear bushing is used. If not properly hardened, permissible load is lowered and the life of the bushing will be shortened

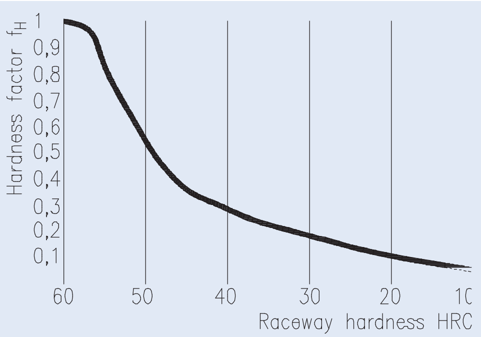


Fig. 1

Temperature coefficient

If the temperature of the linear system exceeds 100˚C, Hardness of the linear system and the shaft lowers to decresure the permissible load compared to that of the linear system used at room temperature rise shortens the rating life.

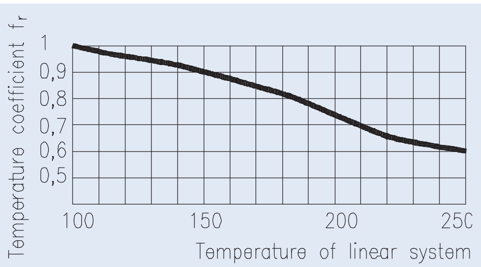


Fig. 2

Contact coefficient

Generally two or more linear bushings are used on one shaft. Thus, the load on each linear system differs depending on each precessing accuracy. Because the linear bushings are not loaded equally, the number of linear bushings per shaft changes the permissible load of system.

Contact coefficient

Table 2

Number of linear systems per shaft	Contact coefficient f_C
1	1,00
2	0,81
3	0,72
4	0,66
5	0,61

Load coefficient

When calculating the load on the linear system, it is necessary to accurately obtain object weight, inertial force based on motion speed, moment load, and each transition as time passes. However, it is difficult to calculate those values accurately because reciprocating motion involves the repetition of start and stop as well as vibration and impact. A more practical approach is to obtain the load coefficient by taking the actual operating conditions into account.

Load coefficient

Table 3

Operating Conditions	fw
Operation at low speed(15m/min. or less) without impulsive shock from outside	1,0 to 1,5
Operation at intermediate speed (60 m/min. or less) without impulsive shock	1,5 to 2,0
Operation at high speed (over 60 m/min.) With impulsive shock from outside	2,0 to 3,5

Frictional resistance

The static frictional resistance of the MTK linear system is so low as to be only slightly different from the kinetic frictional resistance, enabling smooth linear movement from low to high speeds. In general, the friction resistance is expressed by the following equation.

$F = \mu\ W + f,$

where:
F -frictional resistance,
μ -coefficient of friction,
W -load weight,
f -sealing resistance.

The frictional resistance of each MTK linear system depends on the model, load weight, speed, and lubricant. The sealing resistance depends on lip interference and lubricant, regardless of the load weigh. The sealing resistance of one linear system is about 200 to 500 gf. The coefficient of friction depends on the load weight, moment load, and preload. Table 6 shows the coefficient of kinetic friction of each type of linear system which has been instaled and lubricated properly and applied with normal load (P/C= 0,2)

Coefficient of linear system friction

Table 4

Linear System Type	Models	Coefficient of Friction
Linear Bushing	LM LME LMB	0,002 to 0,003

Ambient working temperature

The ambient working temperature range for each MTK linear system depends on the model. Consult MTK on use outside the recommended temperature range.

Temperature conversion equation:

$$C = \frac{5}{9}(F\text{-}32)$$

$$F = 32 + \frac{9}{5}C$$

Ambient working temperature

Table 5

Linear System Type	Models	Ambient Working Temperature
Linear Bushing	LM LME LMB	-20 to 80˚C

Lubrication and dust prevention

Using MTK linear systems without lubrication increases the abrasion of the rolling elements, shortening the life span. The MTK linear systems, therefore require appropriate lubrication. For lubrication MTK recommends turbine oil conforming to ISO Standards G32 to G68 or lithium base soap grease no. 2. Some MTK linear systems are sealed to block dust out and seal lubricant in. If used in a harsh or corrosive enviromment, however, apply a protective cover to the part involving linear motion.

Structure and features

The MTK linear bushing consists of an outer cylinder, ball retainer, balls and two end rings. The ball retainer which holds the balls in the recirculating trucks inheld inside the outer cylinder by end rings.

Those parts are assembled to optimize their required functions.

The outer cylinder is maintained sufficient hardness by heat treatment, therefore if ensures the bushings projected travel life and satisfactory durability.

The ball retainer is made from synthetics to reduce running noise.

High precision and rigidity

The MTK linear bushing is reduced from a solid steel outer cylinder and incorporates an industrial strength resin retainer.

Ease of assembly

The standard type of MTK linear bushing can be loaded from any direction. Precision control is possible using only the shaft supporter, and the mounting surface can be machined easily.

Ease of replacement

MTK linear bushing of each type are completely interchangeable because of their standardized dimensions and strict precision control. Replacement because of wear or damage is therefore easy and accurate.

Variety of types

MTK offers a full line of linear bushing: The standard, integral single - retainer closed type, the clearance adjustable type and the open types. The user can choose from among these according to the application requirements to be met.

Linear ball bushing designation

Designation			
Group I	Group II	Group III	Group IV
Type	Nominal shaft diameter	Modification	Seal

Example:
LM 25 UU AJ

Type:

LM	-metric dimension series most widely used in Japan,
LME	-metric dimension series generally used in Europe,
LMB	-inch dimension series used mainly in USA.

Modification:

No entry	-standard type,
AJ	-adjustable type,
OP	-open type.

Seal:

No entry -no seal,
U -seal on one side,
UU -seals on both sides.

Tolerance

Note that precision of inscribed circle diameters and outside diameters for the clearance adjustable type (...-AJ) and the open type (...-OP) indicates the value obtained before the corresponding type is subjected to cutting process.

Load rating and life expectancy

The life of a linear bushing can be obtained from the following equation with the basic dynamic load rating and the load applied to the bush:

$$L = \left(\frac{f_H \times f_T \times f_C}{f_W \times P} \times \frac{C}{P} \right)^3 \times 50, \qquad (1)$$

where:

L -ratedlife, km,
C -basic dynamic load rating, N,
P -working load, N,
fw -load coefficient,
f_H -hardness factor (see page 340),
f_T -temperature coefficient (see page 340),
f_C -contact coefficient (see page 340).

The lifespan of a linear bushing in hours can be obtained by calculating the travelling distance per unit time.

The lifespan can be obtained from the following equation if the stroke length and the number of strokes are constant:

$$L_h = \left(\frac{L \times 10^3}{2 \times l_s \times n_1 \times 60} \right), \qquad (2)$$

where:

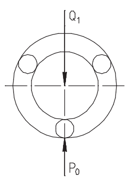
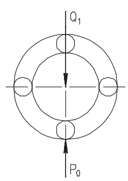
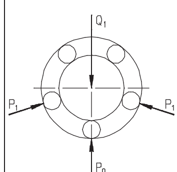
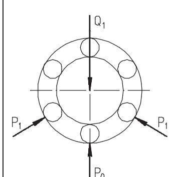
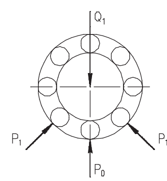
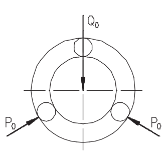
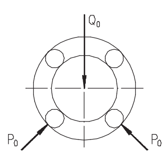
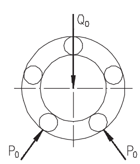
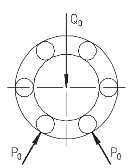
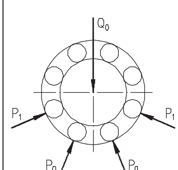
L_h -lifespan, hr,
l_S -stroke length, m,
L -rated life, km,
n_1 -number of strokes per minute, cpm.

Relation between ball circuits and load rating

The MTK linear bushing includes ball circuits that are spaced equally and circumferentially. The load rating varies according to the loaded position on the circumference.

The value in the dimension table indicates the load rating when the load is placed on top of one ball circuit. If the MTK linear bushing is used with two ball circuits loaded uniformly, the load rating will be greater. The following table shows the values by the number of ball circuits in such cases:

Tabel 6

Row position load ratio	Number of rows				
	3	4	5	6	8
Row position load ratio	 $Q_1 = P_0$	 $Q_1 = P_0$	 $Q1 = 1,106P_0$	 $Q1 = 1,354P_0$	 $Q1 = 1,841P_0$
Row position	 $Q_0 = P_0$	 $Q0 = 1,414P_0$	 $Q0 = 1,618P_0$	 $Q0 = 1,732\ P_0$	 $Q0 = 2,052P_0$
Load ratio	$Q_0/Q_1 = 1$	$Q_0/Q_1 = 1,414$	$Q_0/Q_1 = 1,463$	$Q_0/Q_1 = 1,280$	$Q_0/Q_1 = 1,115$

Sample calculations

Obtaining the rated life and lifespan the MTK linear bushing used in the following conditions:

Linear bushing	LM20
Stroke length	50 mm
Number of strokes per minute	50 cpm
Load per bush	490 N

The basic dynamic load rating of the linear bushing is 882N from the dimension table. From equation (1) therefore, the rated life is obtained as follows:

$$L = \left(\frac{f_H \times f_T \times f_C}{f_W \times P} \times \frac{C}{P} \right)^3 \times 50 = \left(\frac{882}{490} \right)^3 \times 50 = 292\,\text{km},$$

where:
$F_H = f_T = f_C = f_W = 1.0$

From equation (2), the lifespan is obtained as followes:

$$L_h = \left(\frac{L \times 10^3}{2 \times e_s \times n_1 \times 60} \right) = \left(\frac{292 \times 10^3}{2 \times 0{,}05 \times 50 \times 60} \right) = 973 \text{ hr}$$

Selecting the linear bushing type satisfying the following conditions:

Number of linear bushing used	4
Stroke length	1 m
Traveling speed	10 m/min
Number of strokes per minute	5 cpm
Lifespan	10 hr
Total load	980 N

From equation (2), the travelling distance within the lifespan is obtained as follows

$L = 2 \text{ x } l_S \text{ x } n_1 \text{ x } 60 \text{ x } L_h = 6\ 000$ km

From ecuation (1), the basic dynamic load rating is obtained as follows:

$$C = \sqrt[3]{\frac{L}{50}} \times \left(\frac{f_W}{f_H \times f_T \times f_C} \right) \times P = 1492 \text{ N}$$

Assume the following with a pair of shafts each with two linear bushings:

$f_C = 0{,}81,\ f_W = f_T = f_H = 1$

As a result, LM30 is selected from the dimension table as the MTK linear bushing type satisfying the value of C.

Clearance and fit

When a standard-type MTK linear bushing is used with a shaft, inadequate clearance, adjustment may cause early bush failure and/or poor, rough traveling. The clearence adjustable linear bush and open linear bush can be clearence adjusted when assembled in the housing which can control the outside cylinder diameter. However, too much clearance adjustment increases the deformation of the outside cylinder, to affect its precision and life. Therefore, the appropriate clearance between the bush and shaft, and clearance between the bush and housing are required according to the application. Table 7 shows recommended fit of the bush:

Table 7

Division / Model	Shaft Normal fit High class	Transi-tional	Housing Loose fit	Tight fit
LM	g6	h6	H7	J7
LMB LME	h6	j6	H7	J7

Note. The clearance may be zero or negative. Please attention the movement.

Shaft and housing

To optimize performance of the MTK linear bushing high precision of the shaft and housing is required.

Shaft

The rolling balls in the MTK linear bushing are in point contact with the shaft surface. Therefore,the shaft dimensions, tolerance, surface finish and hardness greatly affect the travelling performance of the bush. The shaft should be manufactered with due attention to the following points:

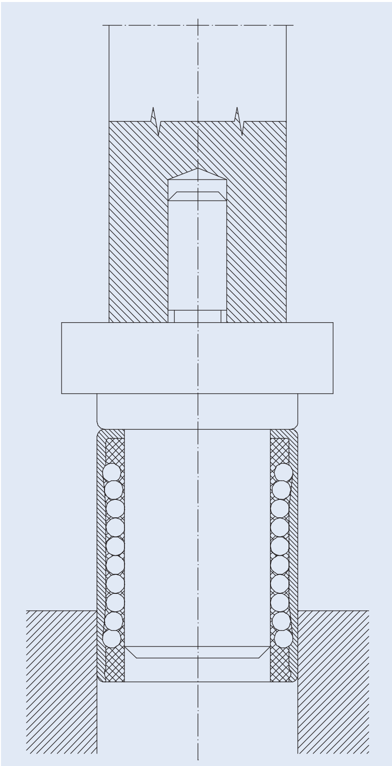
- Since the surface finish critically affects smooth rolling of balls, grind the shaft at 1,5 S or better.
- The best hardness of the shaft is HRC 60 to 64; Hardness less than HRC 60 decreases the life considerably, and hence reduces the permissible load. On the other hand, hardness over HRC 64 accelerates ball wear.
- The shaft diameter for the clearance adjustable linear bush and open linear bush should as much as possible be of the lower value of the inscribed circle diameter in the specification table. Do not set the shaft diameter to the upper value.
- Zero clearance or negative clearance increases the frictional resistance slightly. If the negative clearance is too tight, the deformation of the outside cylinder will become larger, to shorten the bush life.

Housing

There is a wide range of housings differing in design, machining and mounting. For the fitness and shapes of housings see in table 8 and the folowing section on mounting.

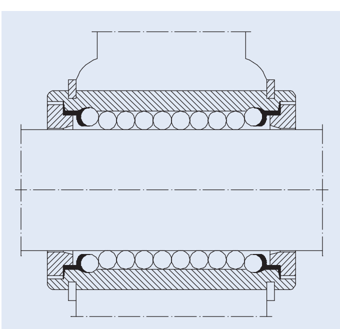
Mounting

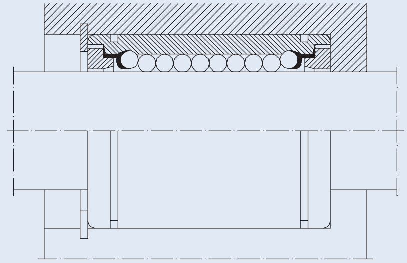
When inserting the linear bush into the bushing do not hit the linear bush on the side ring holding the retainer but apply the cylinder circumference with a proper jig and push the linear bush into the housing by hand or lightly knock it in. In inserting the shaft after mounting the bush, be careful not to shock the balls. Note that if two shafts are used in parallel, the parallelism is the most important factor to assure the smooth linear movement. Take care in setting the shafts.

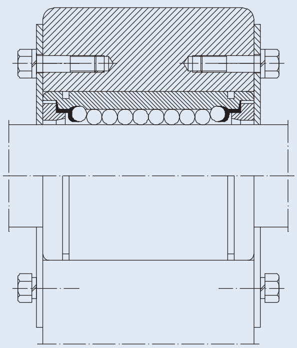


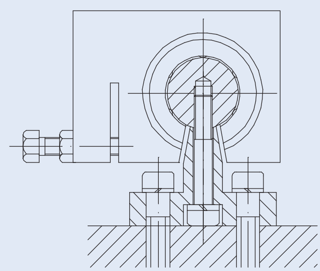
Exemples of mounting

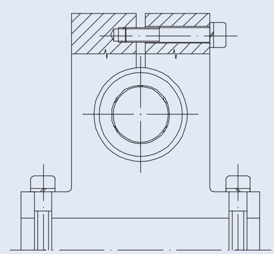
The popular way to mount a linear bush is to operate it with an appropriate interference. It is recommended, however, to make a loose fit in principle because otherwise precision is apt to be minimized. The following examples show assembling of the inserted bush in terms of designing and mounting for reference.











MTK ball bushing interchangeability list

Ball bushing compact type

MTK	NTN	STAR	INA	SKF	FAG
KH . . .	KH . . .	0658 - 0 . . .-00	KH . . .	LBBR . . . LBBS . . .	LNA . . . LFA
KH . . .PP	KH . . .LL	0658 - 2 . . .-40	KH . . .PP	LBBR . . .2LS LBBS . . .2LS	LNA . . .2RS LFA . . .2RS

Ball bushing resin retainer

MTK	NB	INA	SKF	THK	IKO	THOMSON	EASE
LME	KB...G	KB	LBAR / LBCR	LME...	LBE...	MA M...	SDE
LME...UU	KB...GUU	KB...PP	LBAR / LBCR ...2LS	LME...UU	LBE...UU	MA M...WW	SDE . . .UU
LME...AJ	KB...GAJ	KBS...	LBAS...	LME...AJ	LBE...AJ	MA M...ADJ	SDE . . .AJ
LME...UUAJ	KB...GUUAJ	KBS...PP	LBAS...2LS	LME...UUAJ	LBE...UUAJ	MA M...ADJ WW	SDE...UUAJ
LME...OP	KB...GOP	KBO...	LBAT / LBCT...	LME...OP	LBE...OP	MA M...OPN	SDE...OP
LME...UUOP	KB...GUUOP	KBO...PP	LBAT / LBCT...2LS	LME...UUOP	LBE...UUOP	MA M...OPN WW	SDE...UUOP

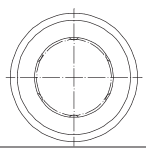
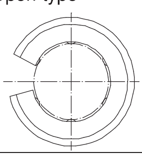
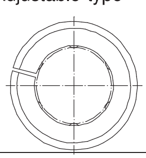
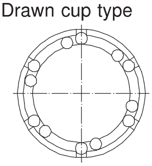
The above types are metric dimension series generally used in Europe.

MTK	NB	THK	EASE
LM...	SM...G	LM	SDM
LM...UU	SM...GUU	LM...UU	SDM...UU
LM...AJ	SM...GAJ	LM...AJ	SDM...AJ
LM...UUAJ	SM...GUUAJ	LM...UUAJN	SDM...UUAJ
LM...OP	SM...GOP	LM...OP	SDM...OP
LM...UUOP	SM...GUUOP	LM...UUOP	SDM...UUOP

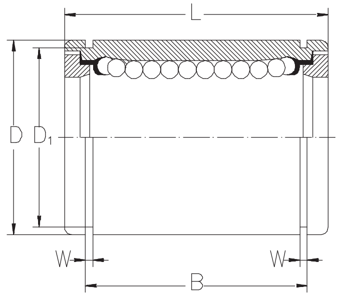
The above types are metric dimension series generally used in Japan and other countries.

MTK	NB	THK	EASE
LMB...	SW...G	LMB	SDB
LMB...UU	SW...GUU	LMB...UU	SDB...UU
LMB...AJ	SW...GAJ	LMB...AJ	SDB...AJ
LMB...UUAJ	SW...GUUAJ	LMB...UUAJ	SDB...UUAJ
LMB...OP	SW...GOP	LMB...OP	SDB...OP
LMB...UUOP	SW...GUUOP	LMB...UUOP	SDB...UUOP

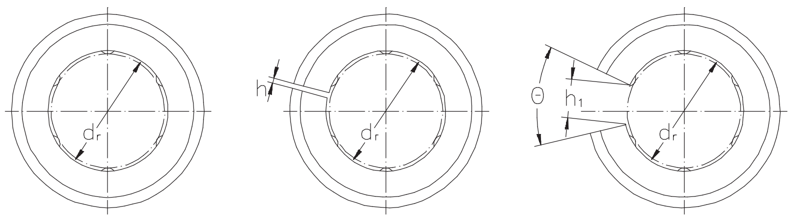
The above types are inch dimension series generally used in US.

Standard type 	page 346 page 348 page 350	
Open type 	page 346 page 348 page 350	One ball circuit (50º - 80º) is removed to allow an opening slot to fit over rail supports.
Adjustable type 	page 346 page 348 page 350	This type has a slot in the outside cylinder. This design allows for clearance adjustment.
Drawn cup type 	page 345	This type linear ball bushings consist of thin walled drawn cups, plastic cages and grade 10 steel balls. Bushings are available with seals at one or both ends.

Linear ball bushing



Nominal part no. Standard type	Seal type	Ball circuit	Weight	Adjustable type	Open type	Nominal shaft diameter	Tolerance
—	—		gr	—	—	mm	
LM 5	**LM 5UU**	4	4	—	—	5	0 / -0,008
LM 6	**LM 6UU**	4	8	**LM 6 AJ**	—	6	0 / -0,009
LM 8S	**LM 8SUU**	4	11	**LM 8S AJ**	—	8	
LM 8	**LM 8UU**	4	16	**LM 8 AJ**	—	8	
LM 10	**LM 10UU**	4	30	**LM 10 AJ**	—	10	
LM 12	**LM 12UU**	4	31,5	**LM 12 AJ**	**LM 12 OP**	12	
LM 13	**LM 13UU**	4	43	**LM 13 AJ**	**LM 13 OP**	13	
LM 16	**LM 16UU**	4	69	**LM 16 AJ**	**LM 16 OP**	16	
LM 20	**LM 20UU**	5	87	**LM 20 AJ**	**LM 20 OP**	20	0 / -0,010
LM 25	**LM 25UU**	6	220	**LM 25 AJ**	**LM 25 OP**	25	
LM 30	**LM 30UU**	6	250	**LM 30 AJ**	**LM 30 OP**	30	
LM 35	**LM 35UU**	6	390	**LM 35 AJ**	**LM 35 OP**	35	0 / -0,012
LM 40	**LM 40UU**	6	585	**LM 40 AJ**	**LM 40 OP**	40	
LM 50	**LM 50UU**	6	1580	**LM 50 AJ**	**LM 50 OP**	50	
LM 60	**LM 60UU**	6	2000	**LM 60 AJ**	**LM 60 OP**	60	0 / -0,015

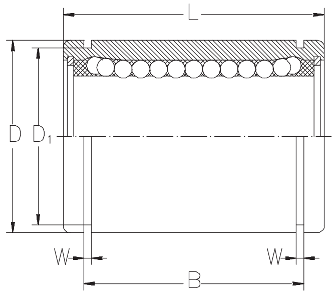


LM LM AJ LM OP

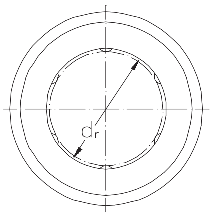
Major dimensions and tolerance D Tolerance	L Tolerance	B Tolerance	W	D1	H	h1		Eccen-tricity max	Radial clearance max	Basic Load C	Rating C_0	Nominal part no.
mm								µm		kN		
$10_{-0,009}^{0}$	$15_{-0,012}^{0}$	$10,2_{-0,2}$	1,1	9,6	—	—	—	8	-3	0,17	0,21	**LM 5**
$12_{-0,011}^{0}$	$19_{-0,02}^{0}$	$13,5_{-0,2}$	1,1	11,5	1	—	—	12	-5	0,21	0,27	**LM 6**
$15_{-0,011}^{0}$	$17_{-0,02}^{0}$	$11,5_{-0,2}$	1,1	14,3	1	—	—	12	-5	0,18	0,23	**LM 8S**
$15_{-0,011}^{0}$	$24_{-0,02}^{0}$	$17,5_{-0,2}$	1,1	14,3	1	—	—	12	-5	0,27	0,41	**LM 8**
$19_{-0,013}^{0}$	$29_{-0,02}^{0}$	$22_{-0,2}$	1,3	18	1			12	-5	0,38	0,56	**LM 10**
$21_{-0,013}^{0}$	$30_{-0,02}^{0}$	$23_{-0,2}$	1,3	20	1,5	8	80°	12	-5	0,42	0,61	**LM 12**
$23_{-0,013}^{0}$	$32_{-0,02}^{0}$	$23_{-0,2}$	1,3	22	1,5	9	80°	12	-7	0,52	0,79	**LM 13**
$28_{-0,013}^{0}$	$37_{-0,02}^{0}$	$26,5_{-0,2}$	1,6	27	1,5	11	80°	12	-7	0,79	1,2	**LM 16**
$32_{-0,016}^{0}$	$42_{-0,02}^{0}$	$30,5_{-0,2}$	1,6	30,5	1,5	11	60°	15	-9	0,88	1,4	**LM 20**
$40_{-0,016}^{0}$	$59_{-0,03}^{0}$	$41_{-0,3}$	1,85	38	2	12	50°	15	-9	1	1,6	**LM 25**
$45_{-0,016}^{0}$	$64_{-0,03}^{0}$	$44,5_{-0,3}$	1,85	43	2,5	15	50°	15	-9	1,6	2,8	**LM 30**
$52_{-0,019}^{0}$	$70_{-0,03}^{0}$	$49,5_{-0,3}$	2,1	49	2,5	17	50°	20	-13	1,7	3,2	**LM 35**
$60_{-0,019}^{0}$	$80_{-0,03}^{0}$	$60,5_{-0,3}$	2,1	57	3	20	50°	20	-13	2,2	4,1	**LM 40**
$70_{-0,022}^{0}$	$100_{-0,03}^{0}$	$74_{-0,3}$	2,6	76,5	3	25	50°	20	-13	3,9	8,1	**LM 50**
$80_{-0,022}^{0}$	$110_{-0,03}^{0}$	$85_{-0,3}$	3,15	86,5	3	30	50°	25	-16	4,8	10,2	**LM 60**

LM<Built- in synthetics resin retainer>
This type is a metric dimension series widely used in Japan and other countries

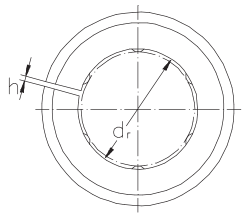
Linear ball bushing



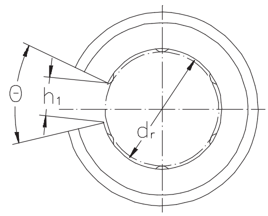
Nominal part no. Standard type	Seal type	Ball circuit	Weight	Adjustable type	Open type	Nominal shaft diameter	Tolerance
—	—		gr	—	—	mm	
LME 5	**LME 5UU**	3	11	**LME 5 AJ**	—	5	+0,008 0
LME 8	**LME 8UU**	4	20	**LME 8 AJ**	—	8	
LME 12	**LME 12UU**	4	41	**LME 12 AJ**	**LME 12 OP**	12	
LME 16	**LME 16UU**	4	57	**LME 16 AJ**	**LME 16 OP**	16	+0,009 -0,001
LME 20	**LME 20UU**	5	91	**LME 20 AJ**	**LME 20 OP**	20	
LME 25	**LME 25UU**	6	215	**LME 25 AJ**	**LME 25 OP**	25	+0,011 -0,001
LME 30	**LME 30UU**	6	325	**LME 30 AJ**	**LM E 30 OP**	30	
LME 40	**LME 40UU**	6	705	**LME 40 AJ**	**LME 40 OP**	40	+0,013 -0,002
LME 50	**LME 50UU**	6	1130	**LME 50 AJ**	**LM E 50 OP**	50	
LME 60	**LME 60UU**	6	2220	**LME 60 AJ**	**LM E 60 OP**	60	



LME



LME AJ



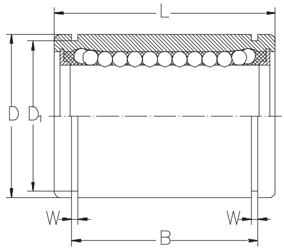
LME OP

Major dimensions and tolerance

D Tolerance	L Tolerance	B Tolerance	W	D1	H	h1		Eccen-tricity max	Radial clearance max	Basic load C	Rating C_0	Nominal part no.
mm								µm		kgF		
$12^{\ 0}_{-0,008}$	$22^{\ 0}_{-0,02}$	$14,5_{-0,2}$	1,1	11,5	1	—	—	12	-5	21	27	**LME 5**
$16^{\ 0}_{-0,008}$	$25^{\ 0}_{-0,02}$	$16,5_{-0,2}$	1,1	15,2	1	—	—	12	-5	21	41	**LME 8**
$22^{\ 0}_{-0,009}$	$32^{\ 0}_{-0,02}$	$22,9_{-0,2}$	1,3	21	1,5	7,5	78˚	12	-7	52	79	**LME 12**
$26^{\ 0}_{-0,009}$	$36^{\ 0}_{-0,02}$	$24,9_{-0,2}$	1,3	24,9	1,5	10	78˚	12	-7	59	91	**LME 16**
$32^{\ 0}_{-0,011}$	$45^{\ 0}_{-0,02}$	$31,5_{-0,2}$	1,6	30,3	2	10	60˚	15	-9	88	140	**LME 20**
$40^{\ 0}_{-0,011}$	$58^{\ 0}_{-0,03}$	$44,1_{-0,3}$	1,85	37,5	2	12,5	60˚	15	-9	100	160	**LME 25**
$47^{\ 0}_{-0,011}$	$68^{\ 0}_{-0,03}$	$52,1_{-0,3}$	1,85	44,5	2	12,5	50˚	15	-9	160	280	**LME 30**
$62^{\ 0}_{-0,013}$	$80^{\ 0}_{-0,03}$	$60,6_{-0,3}$	2,15	59	3	16,8	50˚	17	-13	220	410	**LME 40**
$75^{\ 0}_{-0,013}$	$100^{\ 0}_{-0,03}$	$77,6_{-0,3}$	2,65	72	3	21	50˚	17	-13	390	810	**LME 50**
$90^{\ 0}_{-0,015}$	$125^{\ 0}_{-0,04}$	$101,7_{-0,4}$	3,15	86,5	3	27,2	54˚	20	-16	480	1020	**LME 60**

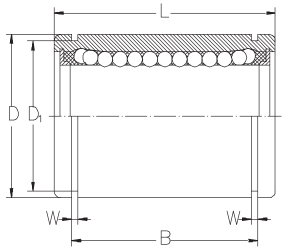
LME<Built- in synthetics resin retainer>
This type is a metric dimension series generally used in Europe.

Linear ball bushing



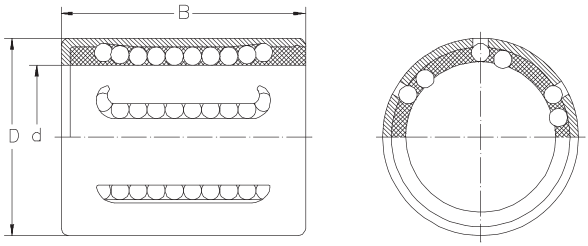
Nominal diameter	Nominal part number						Nominal shaft diameter		Major dimensions and tolerance	
	Standard type	Seal type	Ball circuit	Weight	Adjustable type	Open type		Tolerance	D	Tolerance
inch/mm				kg			inch/mm			
1/4 6,350	**LMB 4**	**LMB 4UU**	4	0,008	**LMB 4 AJ**	—	0,250 6,350	0 -0,0040	0,5000 12,700	0 -0,00045 0 -0,011
3/8 9,525	**LMB 6**	**LMB 6UU**	4	0,014	**LMB 6 AJ**	—	0,3750 9,525		0,6250 15,875	0 -0,00050
1/2 12,700	**LMB 8**	**LMB 8UU**	4	0,037	**LMB 8 AJ**	**LMB 8 OP**	0,5000 12,700	0 -0,0090	0,8750 22,225	0 -0,013
5/8 15,875	**LMB 10**	**LMB 10UU**	4	0,076	**LMB 10 AJ**	**LMB 10 OP**	0,625 15,875		1,1250 28,575	
3/4 19,050	**LMB 12**	**LMB 12UU**	5	0,095	**LMB 12 AJ**	**LMB 12 OP**	0,7500 19,050	0 -0,0040	1,2500 31,750	0 -0,00065
1 25,400	**LMB 16**	**LMB 16UU**	6	0,200	**LMB 16 AJ**	**LMB 16 OP**	1,0000 25,400		1,5625 39,688	
1-1/4 31,750	**LMB 20**	**LMB 20UU**	6	0,440	**LMB 20 AJ**	**LMB 20 OP**	1,2500 31,750	0 -0,0050	2,0000 50,800	0 -0,00075
1-1/2 38,000	**LMB 24**	**LMB 24UU**	6	0,670	**LMB 24 AJ**	**LMB 24 OP**	1,5000 38,100		2,3750 60,325	0 -0,019
2 50,800	**LMB 32**	**LMB 32UU**	6	0,114	**LMB 32 AJ**	**LMB 32 OP**	2,0000 50,800	0 -0,010	3,0000 76,200	0 -0,00090 0 -0,022

LM<Built- in synthetics Resin Retainer>
This type is a metric dimension series widely used in Japan and other countries



L	Tolerance	B	Tolerance	W	D_1	h	h_1		Eccen- tricity max	Radial clearance max	Basic load rating C	C_0	Nominal part no.
inch/mm											N		
0,7500 19,050	0 -0,008	0,5110 12,98	0 -0,008	0,390 0,992	0,4687 11,906	0,04 1	—	—	0,0005 12	-0,0001 -3	206	265	**LMB 4**
	0 -0,200		0 -0,200										
0,8750 22,225		0,6358 16,15		0,390 0,992	0,5880 14,935	0,04 1	—	—	0,0005 12	-0,0001 -3	225	314	**LMB 6**
1,2500 31,750		0,9625 24,46		0,0459 1,168	0,8209 20,853	0,06 1,5	0,34 7,9375	80˚	0,0005 12	-0,0001 -4	510	764	**LMB 8**
1,5000 38,100		1,1039 28,04		0,0559 1,422	1,0590 26,899	0,06 1,5	0,375 9,525	80˚	0,0005 12	-0,0001 -4	774	1180	**LMB 10**
1,6250 41,275		1,1657 29,61		0,0559 1,422	1,1760 29,870	0,06 1,5	0,4375 11,1125	60˚	0,0006 15	-0,0002 -6	862	1370	**LMB 12**
2,2500 57,150	0 -0,012	1,7547 44,57	0 -0,012	0,0679 1,727	1,4687 37,306	0,06 1,5	0,5625 14,2875	50˚	0,0006 15	-0,0002 -6	980	1570	**LMB 16**
2,6250 66,675	0 -0,300	2,0047 50,92	0 -0,300	0,0679 1,727	1,8859 47,904	0,10 2,5	0,625 15,875	50˚	0,0008 20	-0,0003 -8	1570	2740	**LMB 20**
3,0000 76,200		2,4118 61,26		0,0859 2,184	2,2389 56,870	0,12 3	0,75 19,05	50˚	0,0008 20	-0,0003 -8	2180	4020	**LMB 24**
4,0000 101,600		3,1917 81,07		0,1029 2,616	2,8379 72,085	0,12 3	1,0 25,40	50˚	0,0010 25	-0,0005 -13	3820	7940	**LMB 32**
	0 -0,022												

Standard linear ball bushing
Steel drawn cup/cage plastic



Dimensions d	D	B	Load capacity dyn.	stat.	Designation	Weight
mm			N		—	g
6	12	22	400	239	**KH 0622**	7
8	15	24	435	280	**KH 0824**	12
10	17	26	500	370	**KH 1026**	14,5
12	19	28	620	510	**KH 1228**	18,5
14	21	28	620	520	**KH 1428**	20,5
16	24	30	800	620	**KH 1630**	27,5
20	28	30	950	790	**KH 2030**	32,5
25	35	40	1990	1670	**KH 2540**	66
30	40	50	2800	2700	**KH 3050**	95
40	52	60	4400	4450	**KH 4060**	182
50	62	70	5500	6300	**KH 5070**	252