SAMICK Linear Bushing

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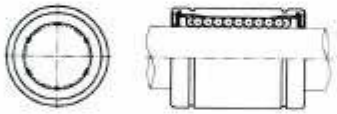
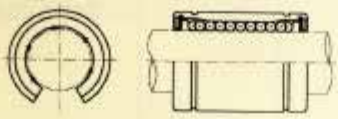
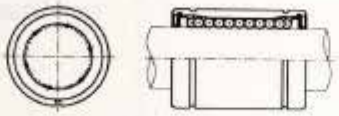
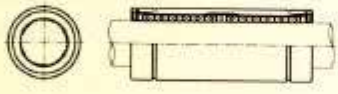
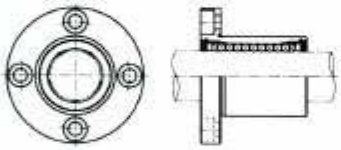
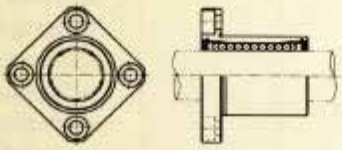
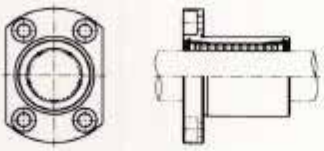
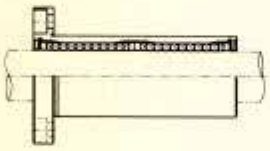
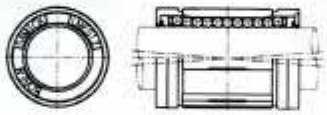
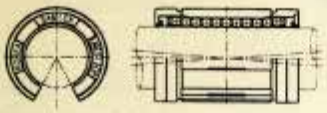
LINEAR BUSHING

TYPE	DESCREPTION	PART NUMBER	FEATURE	PAGE
STANDARD TYPE 		LM LME	• Precision cylinderical shape	30
OPEN TYPE 		LM□OP LME□OP	• One ball circuit has been removed from Standard type series for using with the continuously supproted by Support Rail Unit which provide maximum rigidity and stiffness	30
ADJUSTABLE TYPE 		LM□AJ LME□AJ	• Outer sleeve has been slotted in axial direction	30
LONG TYPE 		LM□L LME□L	• Two retainers are installed in Long type series for using under severe moment loads	34

FLENGED TYPE LINEAR BUSHING

TYPE	DESCREPTION	PART NUMBER	FEATURE	PAGE
CIRCULAR TYPE 		LMF LMEF	• Provide easy Installation by the single body shape	36
SQUARE TYPE 		LMK LMEK	• Compact design is available by lower height of the center than Circular type	36
OVAL TYPE 		LMH	• Compact design is available by lower height of the center than Squar type	36
FLANGED LONG TYPE 		LMF□L LMEF□L LMK□L LMEK□L LMH□L	• Two retainers are installed in Flanged Long type series for using under severe moment loads	40

SUPERBALL

TYPE	DESCREPTION	STAN DARD	PART NUMBER	FEATURE	PAGE
STANDARD TYPE 		ISO (mm)	LMES	• High load capacity • Self alignment • Light weight and silent motion	50
		IMPE RIAL (inch)	LMBS		52
OPEN TYPE 		ISO (mm)	LMES□OP	• One ball circuit has been removed from standard type series for use with the continuously supproted by Support Rail Unit which provide maximum rigidity and stiffness self alignment	51
		IMPE RIAL (inch)	LMBS□OP		53

CASE UNIT AND SUPPORT RAIL UNIT

TYPE AND PART NUMBER		FEATURE		PAGE
CASE UNIT	SC SCE		• Installed Linear Bushing in light weight Aluminum Case Unit • Easy Installation	56, 58, 60
	SC□W SCE□W		• Installed double Linear Bushing in Aluminum Case Unit and good for using under severe moment loads	56, 58, 60
	SC□V SCE□V		• Compact design is available by lighter weight and more compact size than SC type	56, 58, 60
	Adjustable SCJ		• Installed adjustable type Linear Bushing in Aluminum Case Unit • The clearance between the shaft and Linear Bushing can be easily adjusted	62
SUPPORT RAIL UNIT	SBS TBS		• Support Rail Unit probide maximum rigidity and stiffness even under severe load • Available for preventing shaft distorsion	65, 66

SUPPORT RAIL UNIT AND LM SHAFT

TYPE AND PART NUMBER		FEATURE		PAGE
SUPPORT RAIL UNIT	SBR		• Installed Open type Linear Bushing in Aluminum Case Unit • Avalable for long stroke by assembled with SBS type	67
	TBR		• Installed Open type Linear Bushing in Aluminum Case Unit • Avalable for long stroke by assembled with TBS type	68
	SBR□S		• Assembled with Aluminium Case Unit, Support Rail and LM Shaft • Provide cost reduction smooth motion and high rigidity and stiffness	67
	TBR□S		• Assembled with Aluminium Case Unit, Support Rail and LM Shaft • Provide cost reduction, smooth motion and high rigidity and stiffness	68
SHAFT SUPPORT	SK		• Aluminum Shaft Support are light and compact design and also can fix the LM Shaft	70
LM SHAFT	SF		• Shaft for SAMICK Linear Bushing	73

SAMICK LINEAR BUSHING SYSTEM

TECHNICAL INFORMATION

Load Rating and Service Life of Linear Motion Systems

Load Rating and Travel Life

When determining a model that would best suit for your service conditions for a linear motion system, the load rating and travel life of the model must be considered. To consider the load rating you should know the static safety factor of the model calculated based on the basic static load rating. Service life can be assessed by calculating the nominal life based on the basic dynamic load rating and checking to see if the values thus obtained meet your requirements.
The travel life of a linear motion system refers to the total running distance that the linear motion system travels until flaking (the disintegration of a metal surface in scale-like pieces) occurs thereto as a result of the rolling fatigue of the material caused by repeated stress on raceways and rolling elements.

Basic Load Rating

There are two basic load ratings for linear motion systems: basic static load rating(Co), which sets the static permissible limit, and basic dynamic load rating(C).

Basic Static Load Rating Co

If a linear motion system, whether at rest or in motion, receives an excessive load or a large impact, a localized permanent set develops between the raceway and rolling elements, if the magnitude of the permanent set exceeds a certain limit, it hinders the smooth motion of the linear motion system. The basic static load rating refers to a static load in a given direction with given magnitude such that the sum of the permanent set of the rolling elements and that of the raceway at the contact area under the most stress is 0.0001 times greater than the rolling element diameter. In a linear motion systems, the basic static load rating is defined as the radial load. Thus, the basic static load rating provides a limit on the static permissible load. For the rating values of individual linear motion systems, see the respective specification tables in this catalog.

Static Safety Factor fs

A linear motion system may possibly receive an unpredictable external force due to vibration and impact while it is at rest, is moving, or due to inertia resulting from start and stop. It is therefore necessary to consider the static safety factor against operating loads like these.

Static Safety Factor fs

The static safety factor(fs) indicates the ratio of a linear motion system load carrying capacity(basic static load rating Co) to the load exerted there on.

$$fs = \frac{Co}{P} \quad or \quad fs = \frac{Mo}{M} \qquad \cdots\cdots (1)$$

fs : Static safety factor
Co : Basic static load rating (N)
Mo : Static permissible moment $(N \cdot mm)$
P : Calculated load (N)
M : Calculated moment $(N \cdot mm)$

To calculate a load exerted on the linear motion system, the mean load necessary for calculating the service life and the maximum load necessary for calculating the static safety factor must be obtained in advance. In a system that is subjected to frequent starts and stops, is placed under machining loads, and one upon wihich a moment due to an overhang load is forcefully exerted, an excessive load greater than expected may develop. When selecting the correct type of a linear motion system for your purpose, be sure that the type you are considering can bear the maximum possible load, both when stopped and when in operation. The table below specifies the standard values for the static safety factor.

Table 1 Standard Values for The Static Safety Factor(fs)

Machine used	Loading conditions	fs lower limit
Ordinary Industrial Machine	Receives no vibration or impact	1.0~1.3
	Receives vibration and impact	2.0~3.0
Machine tool	Receives no vibration or impact	1.0~1.5
	Receives vibration and impact	2.5~7.0

For large radial loads	$\frac{fH \cdot fT \cdot fc \cdot Co}{P} \geq fs$

Co : Basic static-load rating(radial) (N)
P : Calculated load(radial) (N)
fH : Hardness factor (see Fig 1)
fT : Temperature factor (see Fig 2)
fc : Contact factor (see Table 2)

Basic Dynamic Load Rating C

The basic dynamic load rating (C) refers to a load in a given direction with given magnitude such that when identical linear motion systems in a group are interlocked with one another under the same conditions, the nominal life (L) of the systems is 50km (L=50km) if the systems use balls, and 100km(L=100km) if they use rollers. The basic dynamic load rating (C) is used to calculate the service life of a set of linear motion systems which are interlocked with one another in response to a load. For rating values of individual linear motion systems, see the respective specification tables in this catalog.

Nominal Life

The service lives of linear motion systems more or less vary from system to system even if they are manufactured to the same specifications and remain in service under the same operating conditions. Hence a guideline for determining the service life of a linear motion system is given based on nominal life, Which is defined as follows.
The nominal life refers to the total running distance that 90% of identical linear motion systems in a group, when interlocked with one another under the same conditions, can achieve without flaking developed.
The nominal life (L) of a linear motion system can be obtained from the basic dynamic load rating (C) and applied load(P) using the following equations:

● For linear motion system with balls

$$L = \left(\frac{C}{P}\right)^3 \times 50 \quad \cdots\cdots (2)$$

● For linear motion system with rollers

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

L : Nominal life (*km*)
C : Basic dynamic load rating (*N*)
P : Applied load (*N*)

Service-Life Equation

The service life of the linear motion system can be obtained using the following equation :

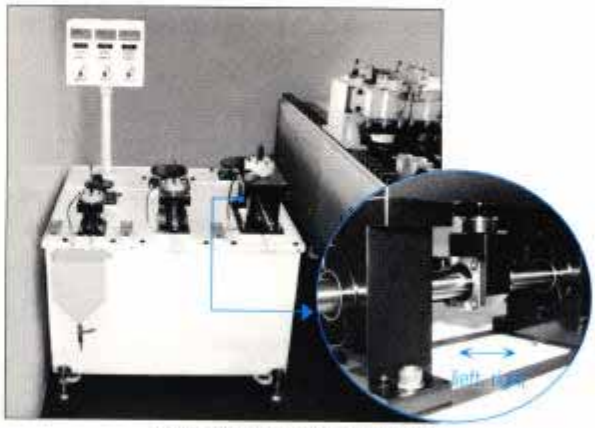
$$L = \left(\frac{f_H \times f_T \times f_C}{f_W} \times \frac{C}{P}\right)^3 \times 50$$

L : Nominal life (*km*)
Total distance that can be traveled by at least 90% of group of Linear Bushings Guides operated under the same conditions.
C : Basic dynamic load rating (*N*)
P : Calculated load (*N*)
f_H : Hardness factor (see Fig 1)
f_T : Temperature factor (see Fig 2)
f_C : Contact factor (see Table 2)
f_W : Load factor (see Table 3)

Once nominal life (L) is obtained using this equation, the Linear Bushing service life can be calculated using the following equation, if the stroke length and the number of strokes per minute are constant :

$$L_h = \frac{L \times 10^6}{2 \times \ell_s \times N_\ell \times 60}$$

L_h : Service life in hours (*hr*)
ℓ_s : Stroke length (*mm*)
N_ℓ : Number of strokes per minute (*cpm*)



Endurance Testing Equipment

f_H : Hardness factor

To ensure achievement of the optimum load rating of the Linear Bushing, the raceway hardness must be 58 to 64 HRC. At a hardness below this range, the basic dynamic and static load ratings decrease. The ratings must therefore be multiplied by the respective hardness factors(f_H). As the Linear Bushing has sufficient hardness, f_H for the Linear Bushing is 1.0 unless otherwise specified.

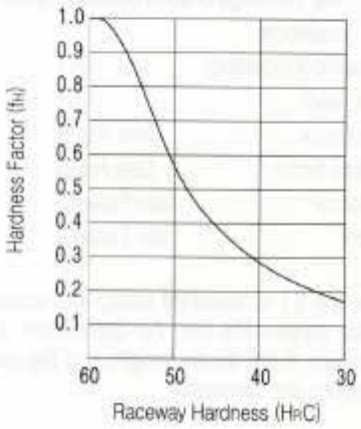


Fig 1 Hardness Factor (f_H)

f_T : Temperature factor

For Linear Bushing used at ambient temperatures over 100℃, a temperature factor corresponding to the ambient temperature, selected from the diagram below, must be taken into consideration. In addition, please note that the selected Linear Bushing itself must be a model with high-temperature specifications.

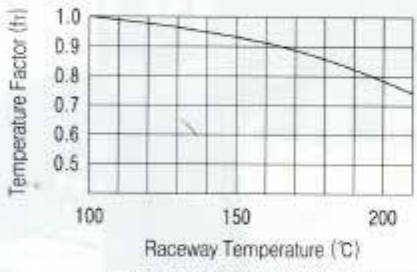


Fig 2 Temperature Factor (f_T)

Note) When used at ambient temperatures higher than 80℃, the seals, end plates, and retainer must be changed to those for high-temperature specifications.

fc : Contact factor

When multiple Linear Bushings are used laid over one another, moments and mounting-surface precision will affect operation, and making it difficult to achieve uniform load distribution. For Linear Bushings used laid over one another, multiply the basic load rating (C or Co) by a contact factor selected from the table below.

Table 2 Contact factor (fc)

Number of Bushings in a shaft	Contact facor (fc)
2	0.81
3	0.72
4	0.66
5	0.61
6 or more	0.6
In normal use	1.0

Note) When the non-uniform load distribution can be predicted, as in a large system, consider using a contact factor.

fw : Load factor

In general, machines in reciprocal motion are likely to cause vibration and impact during operation, and it is particularly difficult to determine the magnitude of vibration that develops during hgh-speed operation, as well as that of impact during repeated starting and stopping in normal use. 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 the table below.

Table 3 Load factor (f_W)

Operating conditions	Load factor (f_W)
Low speed operation(V<15m/min) No impact and vibration	1.0~1.5
Medium speed operation(V<60m/min) Slight impact and vibration	1.5~2.0
High speed operation(V>60m/min) Considerable impact and vibration	2.0~4.0

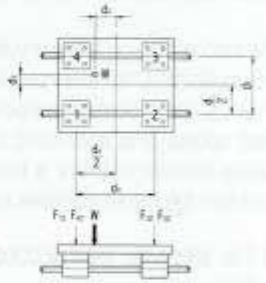
Load Consideration

When designing a linear motion system, it is necessary to consider how the variables of operation will affect performance.
The following examples demonstrate how the position of the load and the center of gravity can influence the product selection. When evaluating your application, review each of the forces acting on your system and determine the best product for your needs.

Terms :

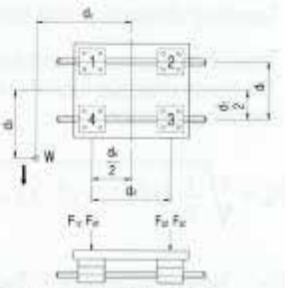
d_0 = Distance between centerlines of case unit
d_1 = Distance between centerlines of LM Shaft
d_2 = Distance from centerline of carriage to load action point
d_3 = Distance from centerline of carriage to load action point
W = Load (N)
F_{NX} = Force in the X-axis direction (N)
F_{NY} = Force in the Y-axis direction (N)
F_{NZ} = Force in the Z-axis direction (N)

$$F_{1Z} = \frac{W}{4} + (\frac{W}{2} \cdot \frac{d_2}{d_0}) - (\frac{W}{2} \cdot \frac{d_3}{d_1})$$
$$F_{2Z} = \frac{W}{4} - (\frac{W}{2} \cdot \frac{d_2}{d_0}) - (\frac{W}{2} \cdot \frac{d_3}{d_1})$$
$$F_{3Z} = \frac{W}{4} - (\frac{W}{2} \cdot \frac{d_2}{d_0}) + (\frac{W}{2} \cdot \frac{d_3}{d_1})$$
$$F_{4Z} = \frac{W}{4} + (\frac{W}{2} \cdot \frac{d_2}{d_0}) + (\frac{W}{2} \cdot \frac{d_3}{d_1})$$



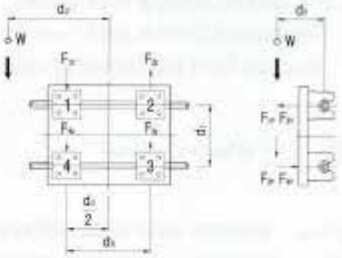
Horizontal Application
At the time of movement with uniform velocity or at the time of stop.

$$F_{1Z} = \frac{W}{4} + (\frac{W}{2} \cdot \frac{d_2}{d_0}) - (\frac{W}{2} \cdot \frac{d_3}{d_1})$$
$$F_{2Z} = \frac{W}{4} - (\frac{W}{2} \cdot \frac{d_2}{d_0}) - (\frac{W}{2} \cdot \frac{d_3}{d_1})$$
$$F_{3Z} = \frac{W}{4} - (\frac{W}{2} \cdot \frac{d_2}{d_0}) + (\frac{W}{2} \cdot \frac{d_3}{d_1})$$
$$F_{4Z} = \frac{W}{4} + (\frac{W}{2} \cdot \frac{d_2}{d_0}) + (\frac{W}{2} \cdot \frac{d_3}{d_1})$$



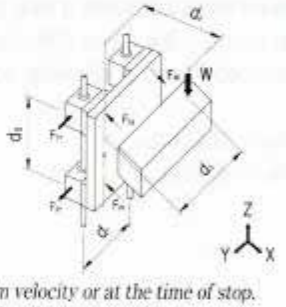
Horizontal Application
At the time of movement with uniform velocity or at the time of stop.

$$F_{1Y} \sim F_{4Y} = (\frac{W}{2} \cdot \frac{d_3}{d_1})$$
$$F_{1Z} = F_{4Z} = \frac{W}{4} + (\frac{W}{2} \cdot \frac{d_2}{d_0})$$
$$F_{2Z} = F_{3Z} = \frac{W}{4} - (\frac{W}{2} \cdot \frac{d_2}{d_0})$$



Side Mounted Application
At the time of movement with uniform velocity or at the time of stop.

$$F_{1X} \sim F_{4X} = \frac{W}{2} \cdot \frac{d_2}{d_0}$$
$$F_{1Y} \sim F_{4Y} = \frac{W}{2} \cdot \frac{d_3}{d_0}$$
$$F_{1X} + F_{4X} \sim F_{2X} + F_{3X}$$
$$F_{1Y} + F_{4Y} \sim F_{2Y} + F_{3Y}$$



Vertical Application
At the time of movement with uniform velocity or at the time of stop.
At the time of start and stop, the load varies because of inertia.

Mean Effective Load at Varying Load

The load acting on a linear system changes depending on the application, for example, when the linear system starts or stops reciprocating motion, while it is operating at a fixed speed, and according to whether the linear system carries work or not. For a fluctuating load, it is important to obtain the mean effective load.

1) For stepwise load according to the travelling distance

Travelling distance L_1 with load P_1
Travelling distance L_2 with load P_2

Travelling distance L_n with load P_n
The mean effective load P_m is obtained from the following equation :

$$P_m = \sqrt[3]{\frac{1}{L}\left(P_1^3 \cdot L_1 + P_2^3 \cdot L_2 \cdots + P_n^3 \cdot L_n\right)}$$

P_m : Mean effective load in fluctuation (N)
L : Total travelling distance (mm)

2) For almost linearly varing load

The mean effective load P_m is approximately obtained from the following equation :

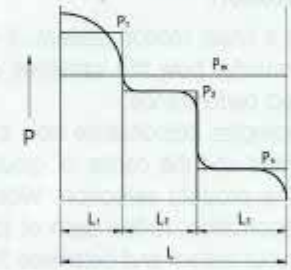
$$P_m \fallingdotseq \frac{1}{3}\left(P_{min} + 2 \cdot P_{max}\right)$$

P_{min} : Minimum value of fluctuating load (N)
P_{max} : Maximum value of fluctuating load (N)

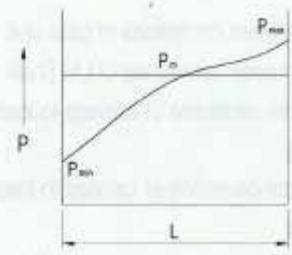
3) When the load draws a sine curve as in (a) or (b)

(a) and (b), the mean effective load P_m is obtained from the following equation :

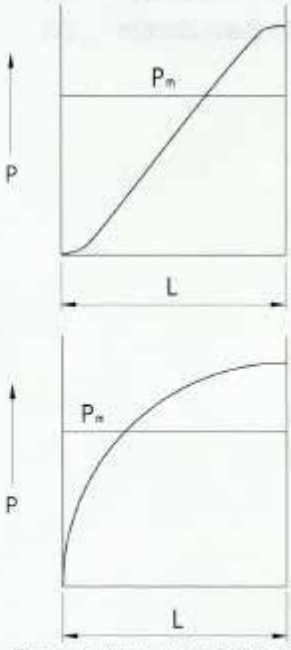
a) $P_m \fallingdotseq 0.65\,P_{max}$
b) $P_m \fallingdotseq 0.75\,P_{max}$



For loads that changes stepwisely



For loads that changes motonously



For loads that changes sinusoidally

SAMICK LINEAR BUSHING SYSTEM

SAMICK LINEAR BUSHING

LINEAR BUSHING

SAMICK Linear Bushing, LM type is the linear motion system with unlimited stroke by applying with LM shaft. Because of the point contact between Balls and LM shaft, minimum friction can be acquired and that can give you the high precision motion.

Components and Features

As shown in Fig 3 SAMICK Linear Bushing serve the alignment of the balls toward the LM shaft by the single retainer and cylinderical shafe of raceway. Outer sleeve is made of high-carbon chrominum bearing steel, and inner and outer grinding process are applied after heat treatment.

Interchangability

The dimensions of SAMICK Linear Bushing are standardized to have full interchangeability. LM shaft is porvided with the cylinderical grinding to have high precision fitting clearance.

Rigid Outer Sleeve

Hardened and precisely ground outer sleeve is made of bearing steel, and can be directly assembled with the needle bearing on outer surface.

High precision Retainer

The single body retainer guids 4~6 ball circuits, and it gives the precision guiding against the balls moving direction and smooth motion.

LM Case Unit

LM Case Unit, SC type is consist of the light aluminum case and LM type Linear Bushing, so the assembly can be finished by simple bolting.
Longer life can be obtained by adjusting the ball circuits orientation of Linear Bushing against the direction of load.

Application

SAMICK Linear Bushing is widly used in precision equipments; computer and peripheral equipments, measuring equipments, auto recording equipments, and 3D measuring equipments, and linear motion systems in machine for mass prodution; multi-axis drilling machines, punching press, tool grinders, auto-gas cutters, printing machines, card selectors, food packing machines, and etc.

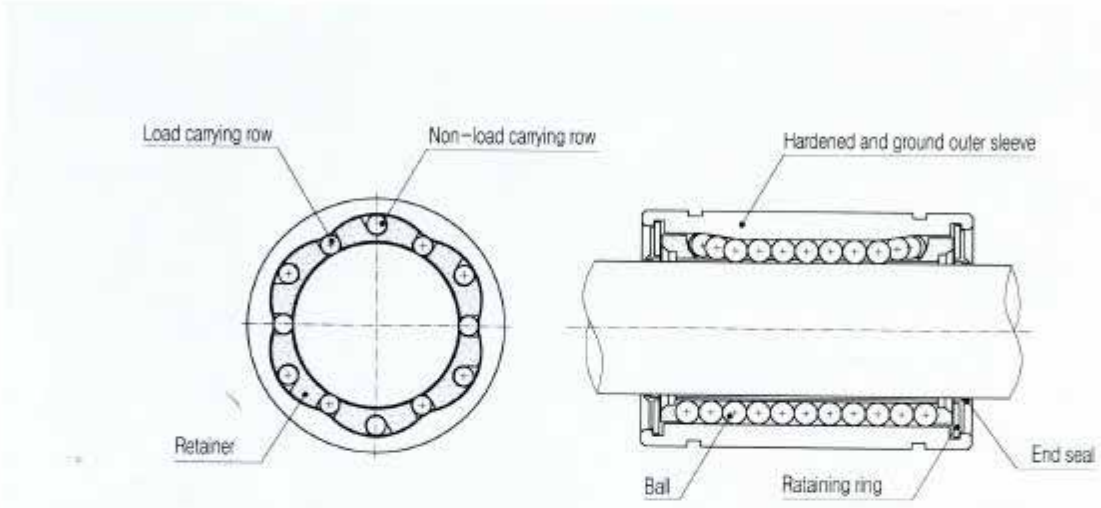
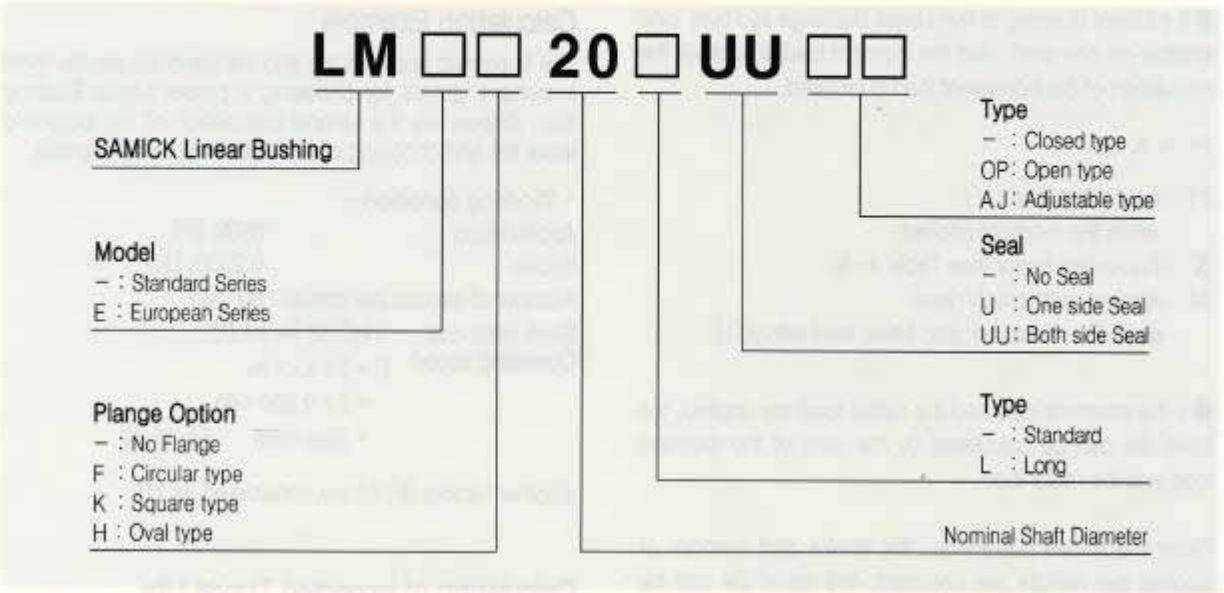


Fig 3 SAMICK LM Series Linear Bushing

Part Number Notation



Standard Tolerance

The tolerance of working bore diameter, outside diameter, and length are specified on the tables in this catalogue, and the value of working bore diameter and outside diameter for adjustable and open types are the obtained value before slotting process.

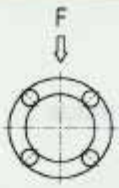
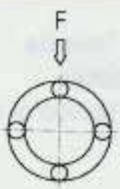
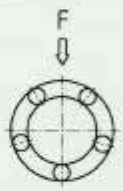
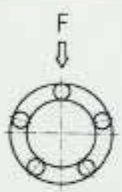
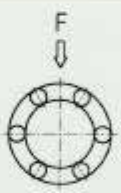
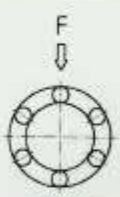
Load rating and Travel Life

The load rating of SAMICK Linear Bushing can be affected by the balls orientation against the load. The basic load rating in the table is the load rating of Linear Bushing when 1 (one) ball circuit are just beneath the load. As shown in Fig 4, If the ball are located on symmetrical position against the load, the load rating will be increased and the travel life will be extended.

$$L = [\frac{f_H \cdot f_C \cdot f_T}{f_W} \times \frac{C}{P}]^3 \times 50$$

L	: Travel life	(km)
C	: Basic dynamic load rating	(N)
P	: Applied load	(N)
f_H	: Hardness factor	(see Fig 1)
f_W	: Load coefficient	(see Table 3)
f_C	: Contact factor	(see Table 2)
f_T	: Temperature factor	(see Fig 3)

Fig 4 Load ratings and Orientation df Balls

No. of Ball Raw	Orientation of Balls	
	Max. Load rating	Min. Load rating
4		
	F=1.41×C	F=C
5		
	F=1.46×C	F=C
6		
	F=1.26×C	F=C

C : Load rating specified on the table

● If a Linear Bushing or two Linear Bushings laid over one another on one shaft, and the moment load is applied, the calculation of the Equivalent load is required.

$P_U \fallingdotseq K \cdot M$

P_U : Equivalent load (N)
when the moment applied
K : Equivalent factor (see Table 4~6)
M : Applied moment ($N \cdot mm$)
ehere Pu should be upto basic load rating(C_0)

● If the moment load and the raidial load are applied, the travel life can be calculated by the sum of the moment load and the radial load.

From the above equations, the stroke and number of strokes per minute are constant, the travel life can be calculated by following equation.

$$L_h = \frac{L \times 10^3}{2 \times Ls \times N_t \times 60}$$

L_h : Travel life (hr)
Ls : Stroke (m)
N_t : Number of strokes per minute (cpm)

Calculation Example

The Maximum applied load and the travel life are the most important factors for choosing a proper Linear Bushing size. Belows are the sample calculation of the expecting travel life and choosing of a proper Linear Bushing size.

- Working condition -

Applied load : 850N (P)
Stroke : 0.250m (Ls)
Number of strokes per minute : 60 (N_t)
Shaft hardness : HRC 60 (f_H =1.0)
Operating speed $V = 2 \times Ls \times N_t$
$= 2 \times 0.250 \times 60$
$= 30 m/min$ (f_H=1.6)

all other factors (fc, fT) are considered as 1.0.

Calculation of expected Travel Life

Since, basic dynamic load rating is based on travel life of 50km and assuming all other factors as 1.0, you can choose the Linear Bushing size that you can expected travel life. Let's try LM40UU with the above working conditions.

$$L = \left(\frac{1.0 \times 1.0 \times 1.0}{1.6} \times \frac{2150}{850} \right)^3 \times 50$$
$$= 197.5 km$$

$$L_h = \frac{197.5 \times 10^3}{2 \times 0.250 \times 60 \times 60}$$
$$= 109.7 hours$$

Choosing a proper Linear Bushing

Let's assume our design travel life is 500hours;
L= 500 X 2 X 0.250 X 10-3 X 60 X 60 = 900km

$$C = \frac{850 \times 1.6}{1.0 \times 1.0 \times 1.0} \times \sqrt[3]{\frac{900}{50}}$$
$$= 3564N$$

So, the proper Linear Bushing for above condition is LM50UU which has 3822N(390kgf) as the basic load rating.

Equivalent factor for Linear Bushing

Table 4 Equivalent factor for LM type

Part Numnber	Equivalent factor : K	
	Single	Double
LM 5	1.253	0.178
LM 6	0.553	0.162
LM 8S	0.708	0.166
LM 8	0.442	0.128
LM 10	0.389	0.101
LM 12	0.389	0.097
LM 13	0.343	0.093
LM 16	0.279	0.084
LM 20	0.257	0.071
LM 25	0.163	0.054
LM 30	0.153	0.049
LM 35	0.143	0.045
LM 40	0.117	0.040
LM 50	0.096	0.032
LM 60	0.093	0.028

note) the Equivalent factor for LMF, LMK, LMH, SC type are same as LM type.

Table 5 Equivalent factor for LM-L type

Part Numnber	Equivalent factor : K
	Single
LM 5L	0.223
LM 6L	0.201
LM 8L	0.151
LM 10L	0.118
LM 12L	0.113
LM 13L	0.107
LM 16L	0.096
LM 20L	0.082
LM 25L	0.060
LM 30L	0.053
LM 35L	0.050
LM 40L	0.043
LM 50L	0.034
LM 60L	0.031

note) the Equivalent factor for LMF-L, LMK-L, LMH-L type are same as LM-L type.

Table 6 Equivalent factor for LME type

Part Numnber	Equivalent factor : K	
	Single	Double
LME 5	0.669	0.123
LME 8	0.514	0.116
LME 12	0.389	0.090
LME 16	0.343	0.081
LME 20	0.291	0.063
LME 25	0.209	0.052
LME 30	0.167	0.045
LME 40	0.127	0.039
LME 50	0.105	0.031
LME 60	0.093	0.024

Short stroke Applications

In applications when the stroke is short, the life of the shaft is shorter than that of the Linear Bushing. In short stroke applications, the required dynamic load rating must be multiplied by the factor Kc found on Fig 5.

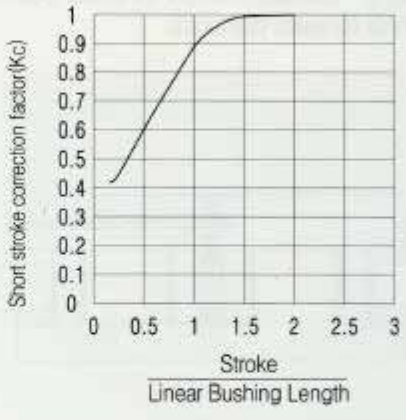


Fig 5 Short stroke correction factor(Kc)

Lubrication and Friction

Lubrication

Usually, Linear Bushing is used with grease lubrication or oil lubrication but in some case, it is used without any lubrication.

Grease Lubrication

Before applying the grease, the anticorrosive oil must be removed by kerosene or organic solvent, and applying the grease after drying. Must applying grease directly on the ball for a both side sealed type (··UU), and applying same as above or applying on the shaft for a without sealed type. Lithium soap radical of viscosity mark No. 2 is recommended for use.

Oil Lubrication

There is no need to remove anticorrosive oil when oil is used for lubrication. ISO viscosity grade VG15~100 oil is usually used according to the temperature.

Operating Temp.	Viscosity
−30℃ ~ 50℃	VG 15 ~ 46
50℃ ~ 80℃	VG 46 ~ 100

The turbine oil, machine oil, and spindle oil are usually used as lubrication oil. Drop the oil on the shaft for lubrication, or supply it through an oil hole provided on the housing (Fig 6). Contact SAMICK for Linear Bushing with lubrication hole for users demands.

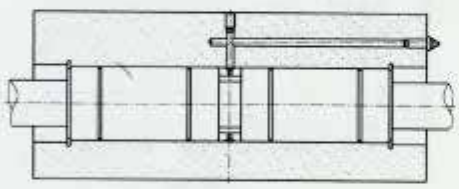


Fig 6

Because the seals remove the oil on shaft, dropping is not recommanded for lubrication for both side seal type.

Coefficient of Friction

Linear Bushing has balls as rollong elements, so the balls can reduce the frictional resistance. Static friction, in praticular, is very low, and there is just little difference between static and dynamic friction, so, that stick-slip does not occur. Such low friction makes submicron feeding possible. The nomal friction codfficient is on Fig 7, and the friction resistance can be calculated by following equation.

$$F = \mu \cdot P + f_S$$

F : Friction resistance force (N)
f : Resistant of seal (0.3~2.4N)
P : Applied load
(Perpendicular load against shaft core) (N)
μ : Friction coefficient(Static or dynamic)

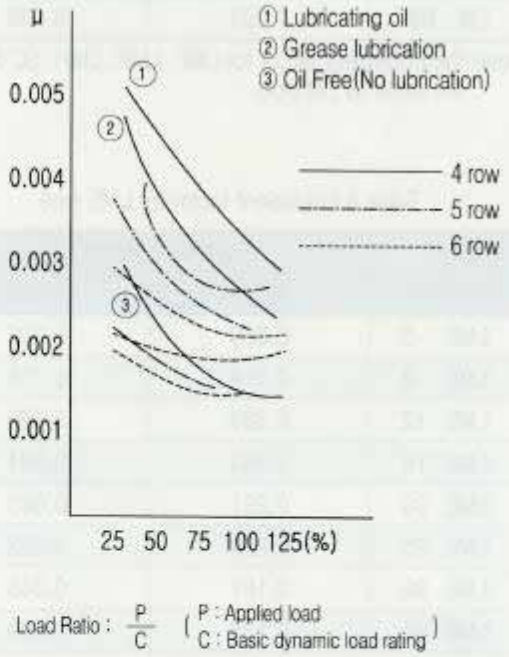


Fig 7 Coefficient of Kinetic Friction

Installation Guid

Tolerance of Housing Bore

Recomended tolerances of Housing bore for SAMICK Linear Bushing are in Table 7. Normal fit is standard, but for without clearance, press fit is also avalible.

Table 7 Tolerance for Housing Bore

Type		Case	
Part Number	Grade	Normal Fit	Pressed Fit
LM	High(H)	H7	J7
LME	–	H7	K6, J6
LMF LMK LMH LM-L LMF-L LMK-L LMH-L	–	H7	J7

Clearance of Outer Sleeve and Shaft

Normal fit is standard for using of Linear Bushing with LM shaft, and for without clearance, Tight fit is also avalable.

Table 8 Tolerance for Shaft Diameter

Type		LM Shaft	
Part Number	Grade	Normal Fit	Tight Fit
LM	High(H)	f6, g6	h6
LME	–	h7	k6
LMF LMK LMH LM-L LMF-L LMK-L LMH-L	–	f6, g6	h6

note) ◆ Negative diametral clearance should not exceed what is specified in the dimension table.
◆ Axial clearance of SC, SCW, SCV type are same as High grade.

Mounting

High holding strength toward LM shaft direction is not required, but just press fit only for mounting is not recommended.
Please see Table 7 for tolerance of Housing Bore.

Standard type

Possible mounting methods are illustrated in Fig 8 and Fig 9. Mount a Linear Brushing with retaining rings and cover plates.

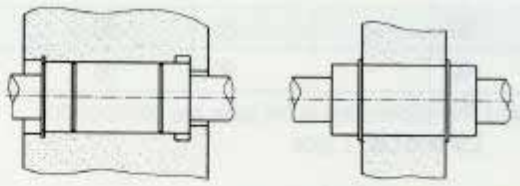


Fig 8 Mounting with retaining rings

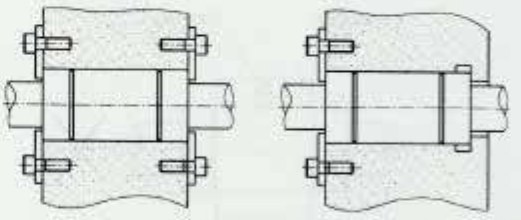


Fig 9 Mounting with cover plates

Retaining ring for Mounting

Retaining rings for mounting LM type SAMICK Linear Bushing are used as showned in the table below.

Table 9 Retaining ring dimensions

Part Number	Retaining ring			
	External (for Shaft)		Internal (for Bore)	
	C Type	NeedleType	C Type	NeedleType
LM 5	10	10	10	10
6	12	12	12	12
8	–	15	15	15
8S	–	15	15	15
10	19	19	19	19
12	21	21	21	21
13	23	22	23	–
16	28	–	28	28
20	32	–	32	32
25	40	40	40	40
30	45	45	45	45
35	52	52	52	52
40	–	60	60	60
50	–	80	80	80
60	–	90	90	90

note) The information in the table are common for LM and LM-L type

Mounting with Setscrew

Mounting a Linear Bushing with a setscrew as shown in Fig 10 will cause deforamtion of the outer sleeve and should be avoided.

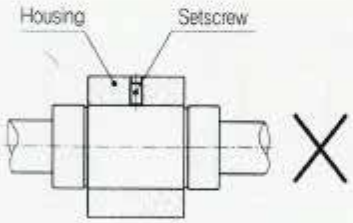
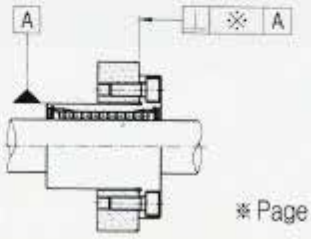


Fig 10 Mounting with Setscrew

Flanged type

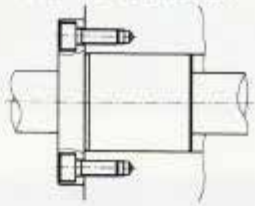
Mounting for LMF, LMK, LMH (Long type also), only mounting the flange with mounting bolt can be all of mounting because of its single body shape.

note) Geometric dimensional tolerance should be considered when outer sleeve is the datum for installation.

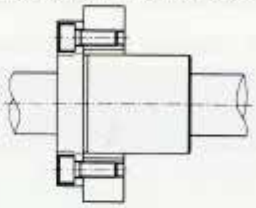


※ Page 36~43

• Mounting from outer sleeve as datum



• Mounting of Flange with mounting bolt



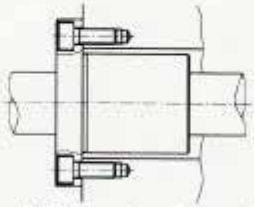


Fig 11 Flanged type Mounting

Mounting of Adjustable type

Adjustment of clearance for adjustable type (...AJ) and LM shaft can be obtained by assemblying with the adjustable type Housing.
In this case, the slotted side of Linear Bushing should be located at 90 ° of open side of housing for equivalent deformation against radial direction. See Fig 12.

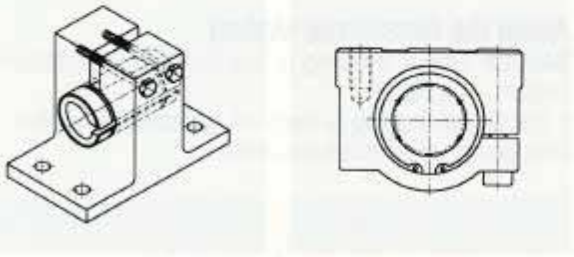


Fig 12 Mounting of adjustable type

Mounting of Open type

Open type (...OP) also can be used with clearance adjustable housing as shown on Fig 13.
Light pre-load is applied for normal using, but heavy pre-load should be avoid.

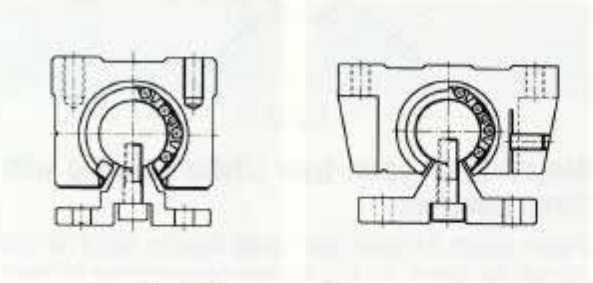


Fig 13 Mounting of Open type

Mounting of Shaft support

Shaft support, SK can be mounted with mounting bolt for table, and LM shaft can be mounted with tightning bolt.

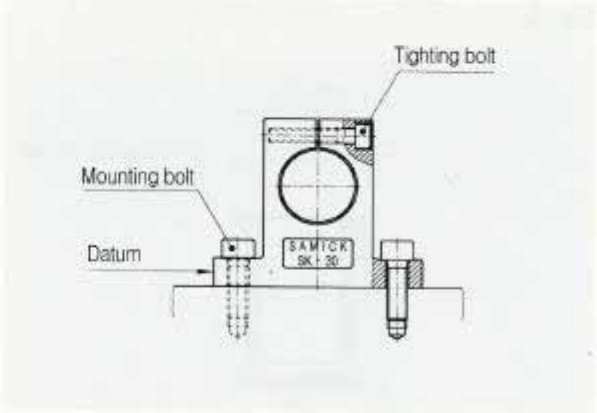


Fig 14 Mounting of Shaft Support

Mounting of LM Case Unit

Mounting of SC type

Mounting of SC, SCW, SCV type from the top and the bottom side with mounting bolt are both available, and it gives you minimum mounting time.

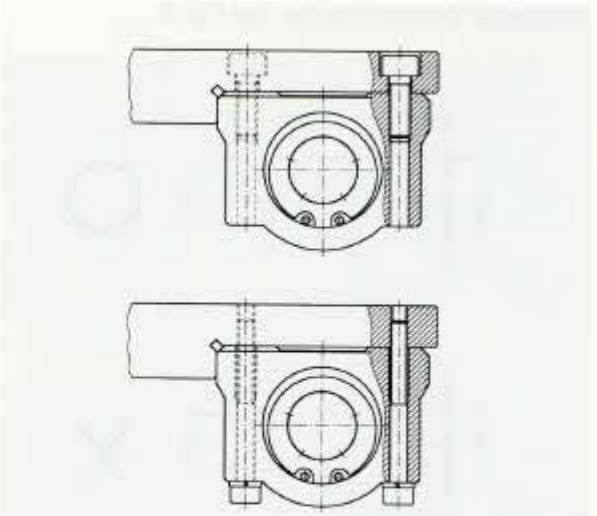


Fig 15 Mounting of Case Unit

Application Tips

Mounting of Linear Bushing

For mounting of a standard type SAMICK Linear Bushing into the Housing, a jig should be used to avoid direct hitting on the outer sleeve or seal during mounting. See Fig 15

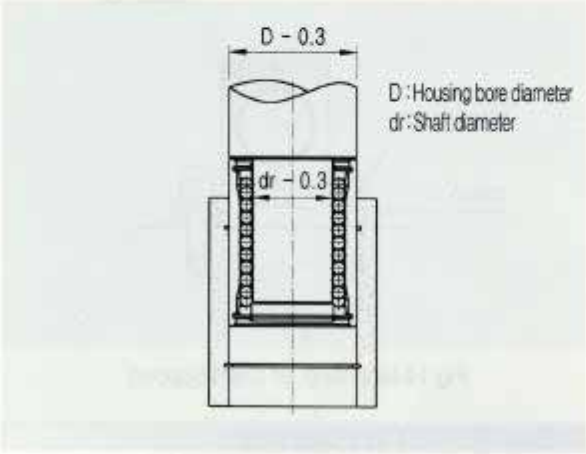


Fig 15 Mounting into houshing

Insertion of Shaft

Care must be thaken to align the bushing and the shaft when inserting a shaft into a Linear Bushing. If the shaft is inserted with slanted, balls may depart from the damaged or deformed retainer. See Fig 16

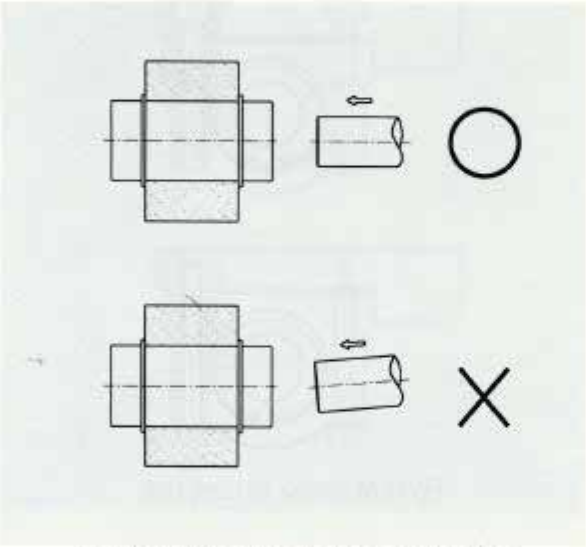


Fig 16 Insertion of shaft into Linear Bushing

When Moment loads applied

External loads should be distributed uniformly on a Linear Bushing. When moment loads are applied, two or more Linear Bushing should be used in one LM shaft, and the distance between two Linear Bushing should be as long as possible. Calculate the equivalant load when the moment loads are applied and choose the proper Linear Bushing. See page 22.

Avoid the Rotaitional Motion

SAMICK Linear Bushing is not suitable for rotational motion. See Fig 18
If the Linear Bushing is exposed to rotaitional motion, it may lead to unexpected accidents.

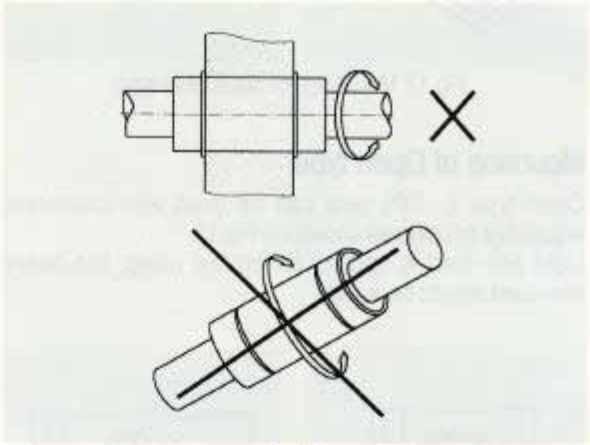


Fig 18

Mounting of open type Linear Bushing with three ball raws

Please mount the open type Linear Bushing with three ball circuit as same as Fig 19 for considering of load distribution.

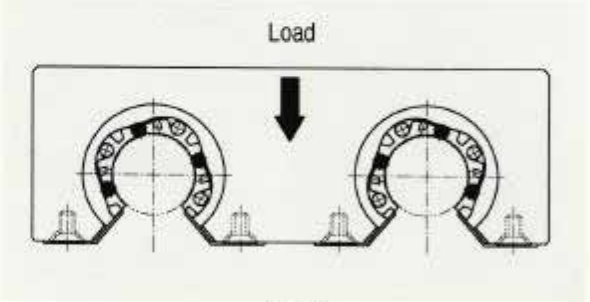
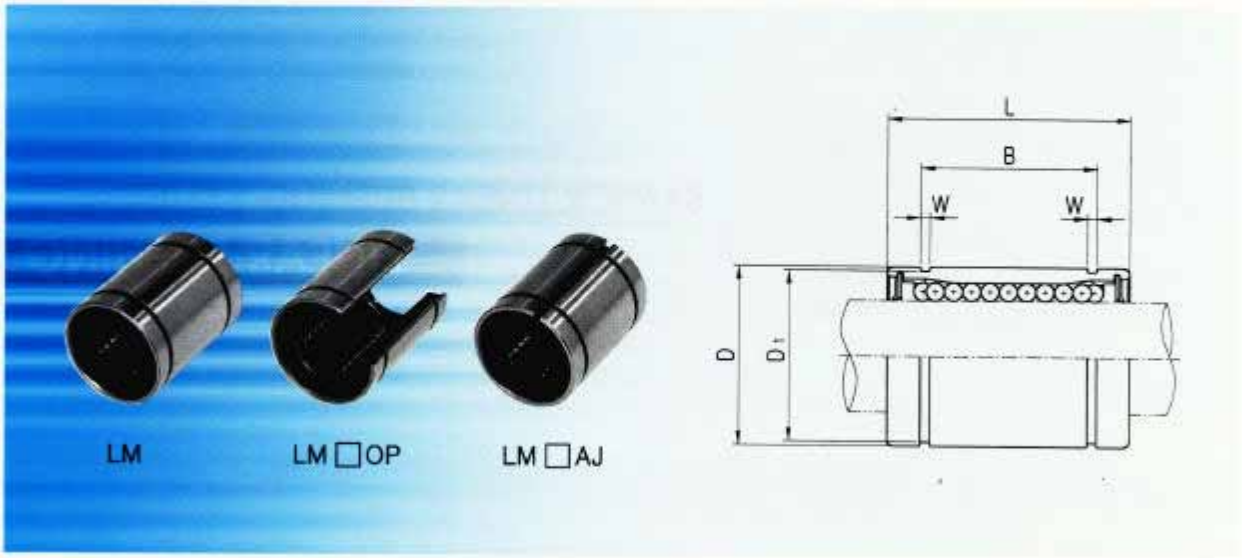


Fig 19

SAMICK LINEAR BUSHING SYSTEM

LINEAR BUSHING

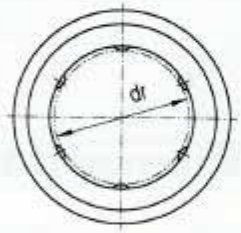
Linear Bushing LM Series



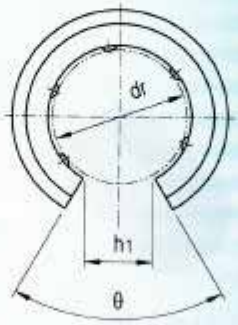
LM Series						Basic Load Ratings		Working Bore Diameter	
Standard type		Open type		Adjustable type					
Part number	No. of Ball circuit	Part number	No. of Ball circuit	Part number	No. of Ball circuit	Dynamic C (N)	Static C_0 (N)	dr (mm)	Tol. (μm)
LM6UU	4	–	–	LM6UUAJ	4	200	260	6	0 −9
LM8SUU	4	–	–	LM8SUUAJ	4	170	220	8	
LM8UU	4	–	–	LM8UUAJ	4	260	400	8	
LM10UU	4	–	–	LM10UUAJ	4	370	540	10	
LM12UU	4	LM12UUOP	3	LM12UUAJ	4	410	590	12	
LM13UU	4	LM13UUOP	3	LM13UUAJ	4	500	770	13	
LM16UU	5	LM16UUOP	4	LM16UUAJ	5	770	1170	16	
LM20UU	5	LM20UUOP	4	LM20UUAJ	5	860	1370	20	0 −10
LM25UU	6	LM25UUOP	5	LM25UUAJ	6	980	1560	25	
LM30UU	6	LM30UUOP	5	LM30UUAJ	6	1560	2740	30	
LM35UU	6	LM35UUOP	5	LM35UUAJ	6	1660	3130	35	0 −12
LM40UU	6	LM40UUOP	5	LM40UUAJ	6	2150	4010	40	
LM50UU	6	LM50UUOP	5	LM50UUAJ	6	3820	7930	50	
LM60UU	6	LM60UUOP	5	LM60UUAJ	6	4700	9990	60	0 −15

note) Plating and RAYDENT treatments are available

1N≒0.102kgf



LM



LM □OP

LM □AJ

Dimensions(mm)											Wgt.* (g)	Allowable Diametral Clearance (μm)	Part Number
D (mm)	D Tol. (μm)	L (mm)	L Tol. (mm)	B (mm)	B Tol. (mm)	W	D_r	h	h_1	θ (°)			
12	0 −11	19	0 −0.2	13.5	0 −0.2	1.1	11.5	1	–	–	8	−5	LM6UU
15		17		11.5		1.1	14.3	1	–	–	11	−5	LM8SUU
15		24		17.5		1.1	14.3	1	–	–	16	−5	LM8UU
19	0 −13	29		22		1.3	18	1	–	–	30	−5	LM10UU
21		30		23		1.3	20	1.5	8	80°	31.5	−5	LM12UU
23		32		23		1.3	22	1.5	9	80°	43	−7	LM13UU
28		37		26.5		1.6	27	1.5	11	80°	69	−7	LM16UU
32	0 −16	42		30.5		1.6	30.5	1.5	11	60°	87	−9	LM20UU
40		59	0 −0.3	41	0 −0.3	1.85	38	2	12	50°	220	−9	LM25UU
45		64		44.5		1.85	43	2.5	15	50°	250	−9	LM30UU
52	0 −19	70		49.5		2.1	49	2.5	17	50°	390	−13	LM35UU
60		80		60.5		2.1	57	3	20	50°	585	−13	LM40UU
80		100		74		2.6	76.5	3	25	50°	1580	−13	LM50UU
90	0 −22	110		85		3.15	86.5	3	30	50°	2000	−16	LM60UU

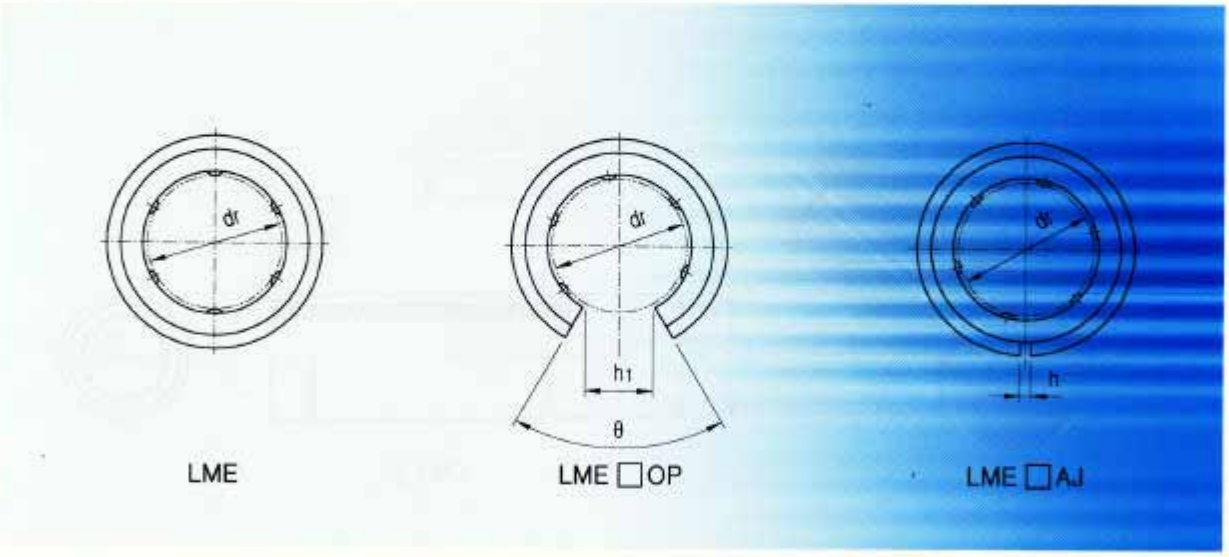
* : the value of Standard type

Linear Bushing LME Series

LME Series						Basic Load Ratings		Working Bore Diameter	
Standard type		Open type		Adjustable type					
Part number	No. of Ball circuit	Part number	No. of Ball circuit	Part number	No. of Ball circuit	Dynamic C (N)	Static C_0 (N)	dr (mm)	Tol. (μm)
LME5UU	4	–	–	LME5UUAJ	4	200	260	5	+8 0
LME8UU	4	–	–	LME8UUAJ	4	260	400	8	
LME12UU	4	LME12UUOP	3	LME12UUAJ	4	500	770	12	
LME16UU	5	LME16UUOP	4	LME16UUAJ	5	570	890	16	+9 −1
LME20UU	5	LME20UUOP	4	LME20UUAJ	5	860	1370	20	
LME25UU	6	LME25UUOP	5	LME25UUAJ	6	980	1560	25	+11 −1
LME30UU	6	LME30UUOP	5	LME30UUAJ	6	1560	2740	30	
LME40UU	6	LME40UUOP	5	LME40UUAJ	6	2150	4010	40	+13 −2
LME50UU	6	LME50UUOP	5	LME50UUAJ	6	3820	7930	50	
LME60UU	6	LME60UUOP	5	LME60UUAJ	6	4700	9990	60	

note) Plating and RAYDENT treatments are available

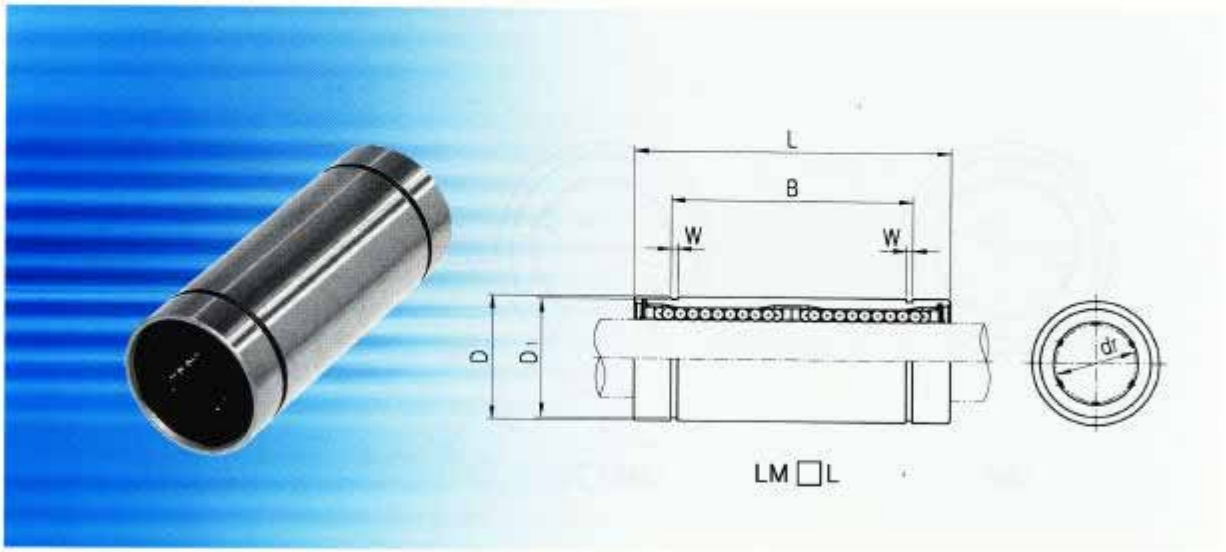
1N≒0.102kgf



Dimensions(mm)											Wgt.* (g)	Allowable Diametral Clearance (μm)	Part Number
D (mm)	Tol. (μm)	L (mm)	Tol. (mm)	B (mm)	Tol. (mm)	W	D_1	h	h_1	θ (°)			
12	0 −8	22	0 −0.2	14.5	0 −0.2	1.1	11.5	1	–	–	12	−5	LME5UU
16		25		16.5		1.1	15.2	1	–	–	20	−5	LME8UU
22	0 −9	32		22.9		1.3	21	1.5	7.5	78°	41	−7	LME12UU
26		36		24.9		1.3	24.9	1.5	10	78°	57	−7	LME16UU
32	0 −11	45		31.5		1.6	30.3	2	10	60°	91	−9	LME20UU
40		58	0 −0.3	44.1	0 −0.3	1.85	37.5	2	12.5	60°	215	−9	LME25UU
47		68		52.1		1.85	44.5	2	12.5	50°	325	−9	LME30UU
62	0 −13	80		60.6		2.15	59	3	16.8	50°	705	−13	LME40UU
75		100		77.6		2.65	72	3	21	50°	1130	−13	LME50UU
90	0 −15	125	0 −0.4	101.7	0 −0.4	3.15	86.5	3	27.2	54°	2220	−16	LME60UU

* : the value of Standard type

Linear Bushing LM□L Series

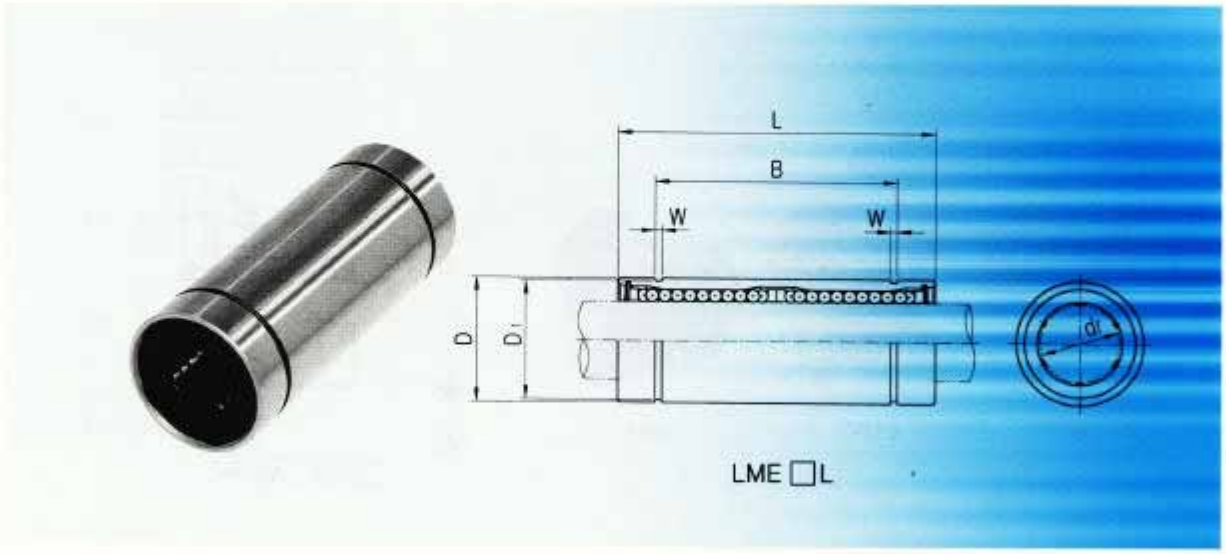


LM□L Series		Working Bore Diameter		Dimensions(mm)									Basic Load Ratings	
Part number	No. of Ball circuit	dr (mm)	Tol. (μm)	D (mm)	Tol. (μm)	L (mm)	Tol. (mm)	B (mm)	Tol. (mm)	W	D1	Wgt. (g)	Dynamic C (N)	Static C0 (N)
LM6LUU	4	6	0 −10	12	0 −13	35	0 −0.3	27	0 −0.3	1.1	11.5	16	320	520
LM8LUU	4	8		15		45		35		1.1	14.3	31	430	780
LM10LUU	4	10		19	0 −16	55		44		1.3	18	62	580	1100
LM12LUU	4	12		21		57		46		1.3	20	80	650	1200
LM13LUU	4	13		23		61		46		1.3	22	90	810	1570
LM16LUU	5	16		28		70		53		1.6	27	145	1230	2350
LM20LUU	5	20	0 −12	32	0 −19	80		61		1.6	30.5	180	1400	2750
LM25LUU	6	25		40		112	0 −0.4	82	0 −0.4	1.85	38	440	1560	3140
LM30LUU	6	30		45		123		89		1.85	43	580	2490	5490
LM35LUU	6	35	0 −15	52	0 −22	135		99		2.1	49	795	2650	6470
LM40LUU	6	40		60		154		121		2.1	57	1170	3430	8040
LM50LUU	6	50		80		192		148		2.6	76.5	3100	6080	15900
LM60LUU	6	60	0 −20	90	0 −25	211		170		3.15	86.5	3500	7650	20000

note) Plating and RAYDENT treatments are available

1N≒0.102kgf

Linear Bushing LME□L Series

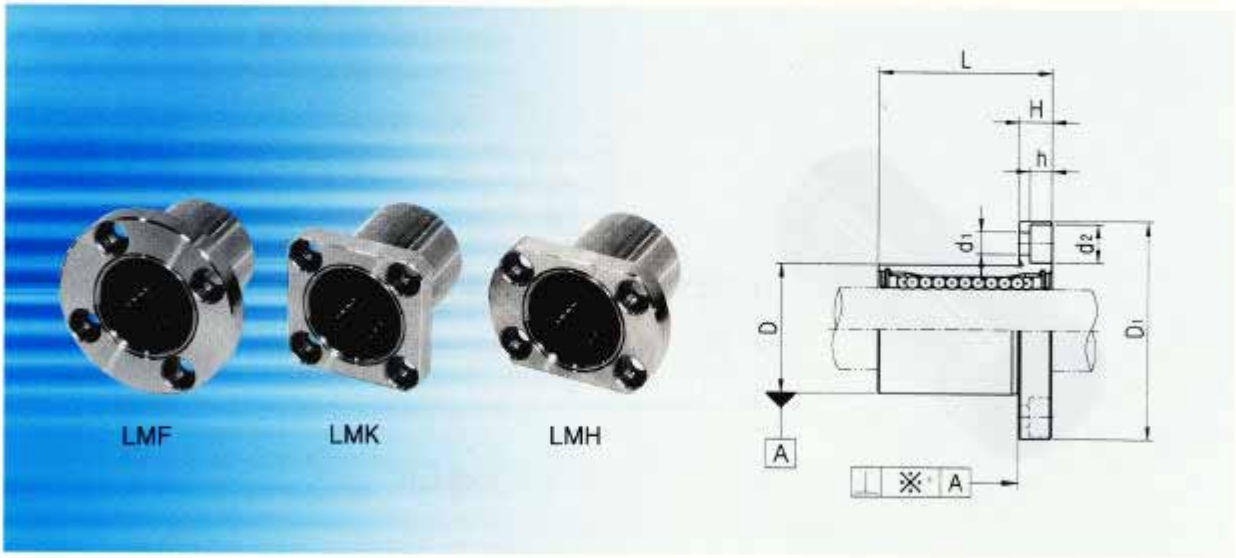


LME□L Series		Working Bore Diameter		Dimensions(mm)								Wgt. (gf)	Basic Load Ratings	
Part number	No. of Ball circuit	dr (mm)	Tol. (μm)	D (mm)	D Tol. (μm)	L (mm)	L Tol. (mm)	B (mm)	B Tol. (mm)	W	D1		Dynamic C (N)	Static C0 (N)
LME8LUU	4	8	+9 −1	16	0 / −9	45	0 −0.3	33	0 −0.3	1.1	15.2	31	430	780
LME12LUU	4	12		22	0 −11	57		45.8		1.3	21	80	650	1200
LME16LUU	5	16	+11 −1	26		70		49.8		1.3	24.9	145	1230	2350
LME20LUU	5	20		32	0 −13	80		61		1.6	30.3	180	1400	2750
LME25LUU	6	25	+13 −2	40		112	0 −0.4	82	0 −0.4	1.85	38	440	1560	3140
LME30LUU	6	30		47		123		104.2		1.85	44.5	580	2490	5490
LME40LUU	6	40	+16 −4	62	0 −15	154		121.2		2.15	59	1170	3430	8040
LME50LUU	6	50		75		192		155.2		2.65	72	3100	6080	15900
LME60LUU	6	60		90	0 −20	211		170		3.15	86.5	3500	7650	20000

note) Plating and RAYDENT treatments are available

1N≒0.102kgf

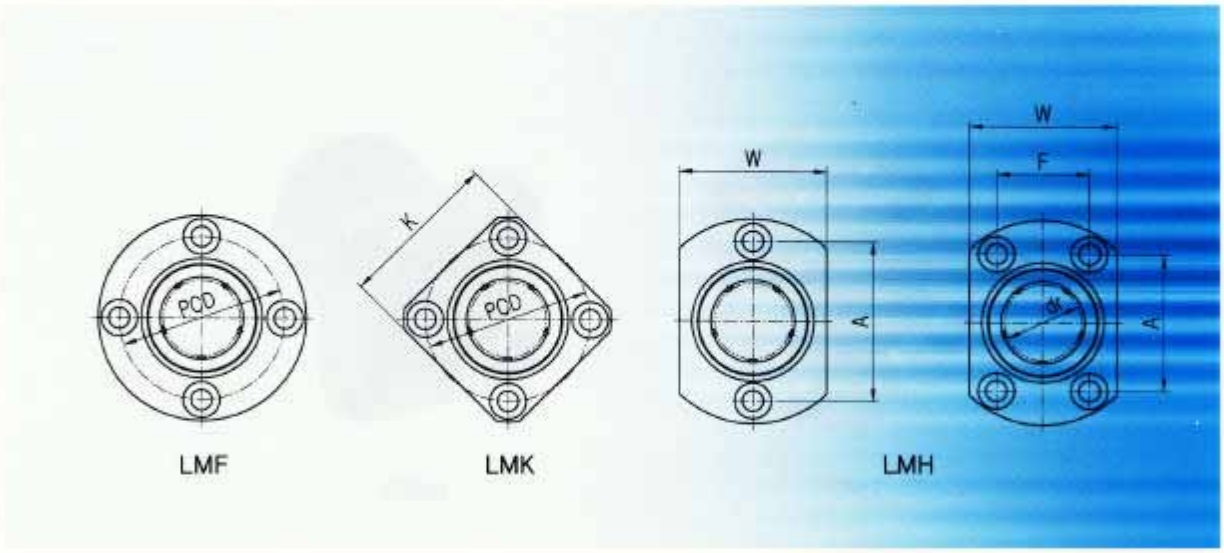
Linear Bushing LMF/K/H Series



Part number			No. of Ball circuit	Wgt.* (gr)	Allowable Diametral Clearance (μm)	Basic Load Ratings		Working Bore Diameter	
Circular type	Square type	Oval type				Dynamic C (N)	Static C_0 (N)	dr (mm)	Tol. (μm)
LMF6UU	LMK6UU	LMH6UU	4	26.5	−5	200	260	6	0 −9
LMF8SUU	LMK8SUU	–	4	34	−5	170	220	8	
LMF8UU	LMK8UU	LMH8UU	4	40	−5	260	400	8	
LMF10UU	LMK10UU	LMH10UU	4	78	−5	370	540	10	
LMF12UU	LMK12UU	LMH12UU	4	76	−5	410	590	12	
LMF13UU	LMK13UU	LMH13UU	4	94	−7	500	770	13	
LMF16UU	LMK16UU	LMH16UU	5	134	−7	770	1170	16	
LMF20UU	LMK20UU	LMH20UU	5	180	−9	860	1370	20	0 −10
LMF25UU	LMK25UU	LMH25UU	6	340	−9	980	1560	25	
LMF30UU	LMK30UU	LMH30UU	6	460	−9	1560	2740	30	
LMF35UU	LMK35UU	–	6	795	−13	1660	3130	35	0 −12
LMF40UU	LMK40UU	–	6	1054	−13	2150	4010	40	
LMF50UU	LMK50UU	–	6	2200	−13	3820	7930	50	
LMF60UU	LMK60UU	–	6	2960	−16	4700	9990	60	0 −15

note) Plating and RAYDENT treatments are available

1N≒0.102kgf



LMF LMK LMH

Dimensions(mm)														Part number
D (mm)	Tol. (μm)	L (mm)	Tol. (mm)	D_1 (mm)	Tol. (mm)	H	PCD	K	W	A	F	Squareness * (μm)	$d_1 \times d_2 \times h$	
12	0 −11	19	0 −0.2	28	0 −0.2	5	20	22	18	20	–	12	3.4×6.5×3.3	LMF/K/H 6UU
15		17		32		5	24	25	–	–	–	12	3.4×6.5×3.3	LMF/K 8SUU
15		24		32		5	24	25	21	24	–	12	3.4×6.5×3.3	LMF/K/H 8UU
19	0 −13	29		40		6	29	30	25	29	–	12	4.5×8×4.4	LMF/K/H 10UU
21		30		42		6	32	32	27	32	–	12	4.5×8×4.4	LMF/K/H 12UU
23		32		43		6	33	34	29	33	–	12	4.5×8×4.4	LMF/K/H 13UU
28		37		48		6	38	37	34	31	22	12	4.5×8×4.4	LMF/K/H 16UU
32	0 −16	42		54		8	43	42	38	36	24	15	5.5×9.5×5.4	LMF/K/H 20UU
40		59	0 −0.3	62		8	51	50	46	40	32	15	5.5×9.5×5.4	LMF/K/H 25UU
45		64		74		10	60	58	51	49	35	15	6.6×11×6.5	LMF/K/H 30UU
52	0 −19	70		82		10	67	64	–	–	–	20	6.6×11×6.5	LMF/K 35UU
60		80		96	0 −0.3	13	78	75	–	–	–	20	9×14×8.6	LMF/K 40UU
80		100		116		13	98	92	–	–	–	20	9×14×8.6	LMF/K 50UU
90	0 −22	110		134		18	112	106	–	–	–	25	11×17.5×10.8	LMF/K 60UU

* : the value of Circular type

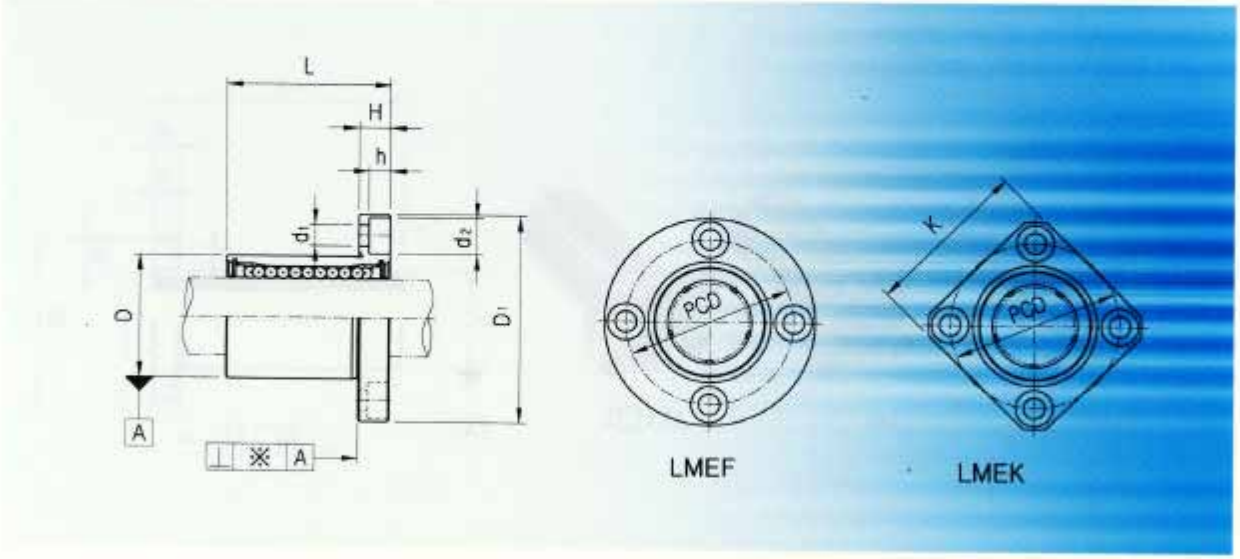
Linear Bushing LMEF/K Series

LMEF LMEK

Part number		No. of Ball circuit	Wgt.* (gr)	Allowable Diametral Clearance (μm)	Basic Load Ratings		Working Bore Diameter	
Circular type	Square type				Dynamic C (N)	Static C_0 (N)	dr (mm)	Tol. (μm)
LMEF8UU	LMEK8UU	4	44	−5	260	400	8	+8 0
LMEF12UU	LMEK12UU	4	86	−5	500	770	12	
LMEF16UU	LMEK16UU	5	120	−7	570	890	16	+9 −1
LMEF20UU	LMEK20UU	5	184	−9	860	1370	20	
LMEF25UU	LMEK25UU	6	335	−9	980	1560	25	+11 −1
LMEF30UU	LMEK30UU	6	545	−9	1560	2740	30	
LMEF40UU	LMEK40UU	6	1185	−13	2150	4010	40	+13 −2
LMEF50UU	LMEK50UU	6	1730	−13	3820	7930	50	
LMEF60UU	LMEK60UU	6	3180	−16	4700	9990	60	

note) Plating and RAYDENT treatments are available

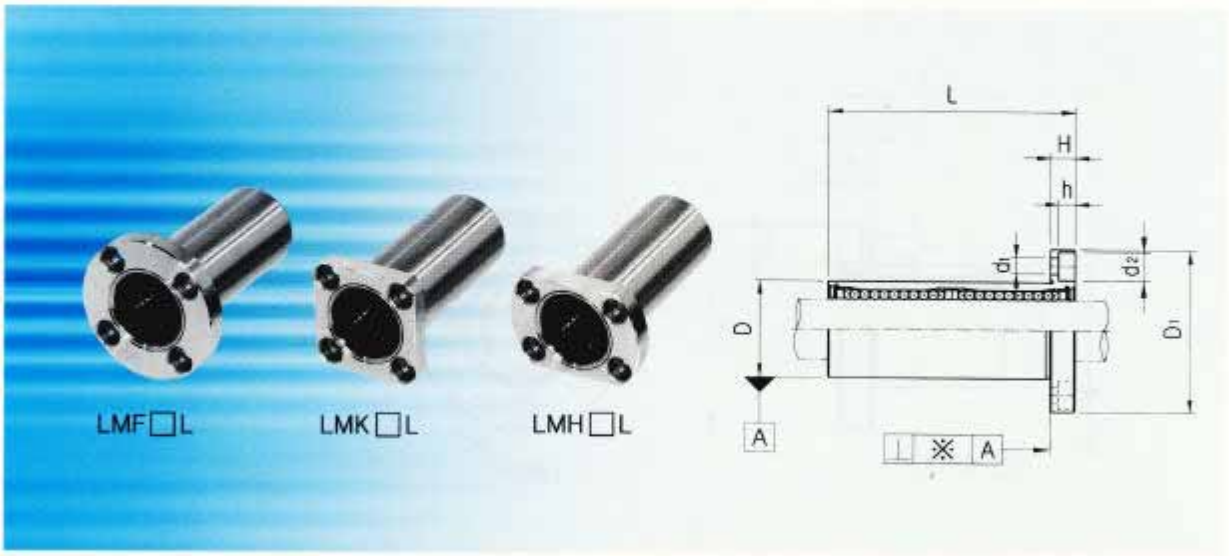
1N≒0.102kgf



Dimensions(mm)											Part number
D (mm)	Tol. (μm)	L (mm)	Tol. (mm)	D_1 (mm)	Tol. (mm)	H	PCD	K	Squareness ※ (μm)	$d_1 \times d_2 \times h$	
16	0 / -8	25	0 -0.2	32	0 -0.2	5	24	25	12	3.4×6.5×3.3	LMEF/K 8UU
22	0 -9	32		42		6	32	32	12	4.5×8×4.4	LMEF/K 12UU
26		36		46		6	36	35	12	4.5×8×4.4	LMEF/K 16UU
32	0 -11	45		54		8	43	42	15	5.5×9.5×5.4	LMEF/K 20UU
40		58	0 -0.3	62		8	51	50	15	5.5×9.5×5.4	LMEF/K 25UU
47		68		76		10	62	60	15	6.6×11×6.5	LMEF/K 30UU
62	0 -13	80		98		13	80	75	20	9×14×8.6	LMEF/K 40UU
75		100		112	0 -0.3	13	94	88	20	9×14×8.6	LMEF/K 50UU
90	0 -15	125	0 -0.4	134		18	112	106	25	11×17.5×10.8	LMEF/K 60UU

* : the value of Circular type

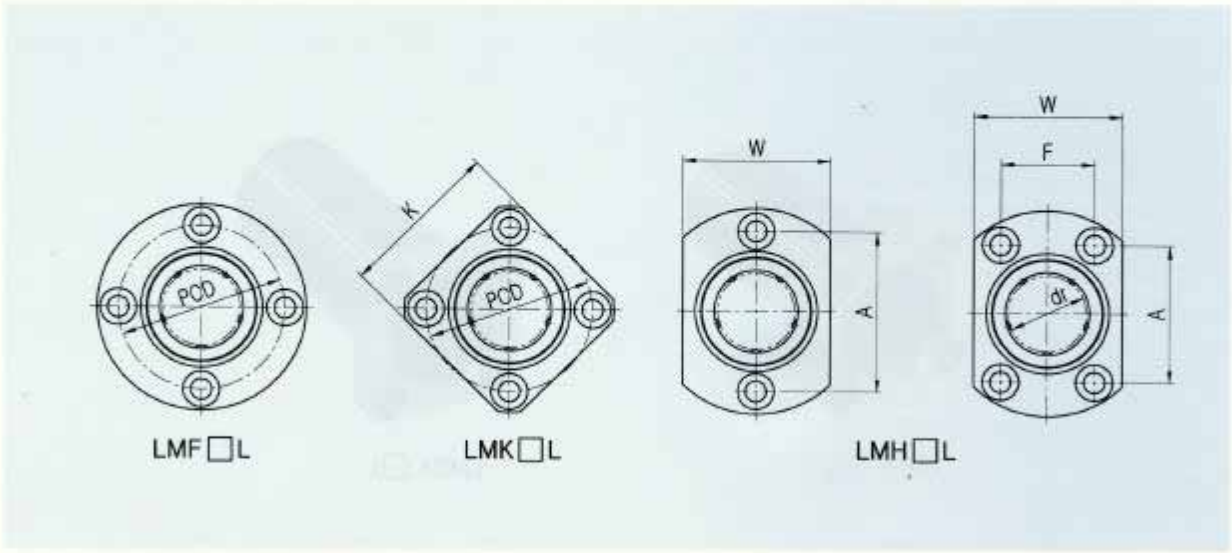
Linear Bushing LMF/K/H□L Series



Part number			No. of Ball circuit	Wgt.* (g)	Allowable Diametral Clearance (μm)	Basic Load Ratings		Working Bore Diameter	
Circular type	Square type	Oval type				Dynamic C (N)	Static C_0 (N)	dr (mm)	Tol. (μm)
LMF6LUU	LMK6LUU	LMH6LUU	4	31	−5	320	520	6	0 −10
LMF8LUU	LMK8LUU	LMH8LUU	4	53	−5	430	780	8	
LMF10LUU	LMK10LUU	LMH10LUU	4	105	−5	580	1100	10	
LMF12LUU	LMK12LUU	LMH12LUU	4	100	−5	650	1200	12	
LMF13LUU	LMK13LUU	LMH13LUU	4	130	−7	810	1570	13	
LMF16LUU	LMK16LUU	LMH16LUU	5	187	−7	1230	2350	16	
LMF20LUU	LMK20LUU	LMH20LUU	5	260	−9	1400	2750	20	0 −12
LMF25LUU	LMK25LUU	LMH25LUU	6	515	−9	1560	3140	25	
LMF30LUU	LMK30LUU	LMH30LUU	6	655	−9	2490	5490	30	
LMF35LUU	LMK35LUU	–	6	970	−13	2650	6470	35	0 −15
LMF40LUU	LMK40LUU	–	6	1560	−13	3430	8040	40	
LMF50LUU	LMK50LUU	–	6	3500	−13	6080	15900	50	
LMF60LUU	LMK60LUU	–	6	4500	−16	7650	20000	60	0 −20

note) Plating and RAYDENT treatments are available

1N≒0.102kgf



LMF□L LMK□L LMH□L

Dimensions(mm)														Part number
D (mm)	D Tol. (μm)	L (mm)	L Tol. (mm)	D_1 (mm)	D_1 Tol. (mm)	H	PCD	K	W	A	F	Squareness * (μm)	$d_1 \times d_2 \times h$	
12	0 −13	35	0 −0.3	28	0 −0.2	5	20	22	18	20	–	15	3.4×6.5×3.3	LMF/K/H 6LUU
15		45		32		5	24	25	21	24	–	15	3.4×6.5×3.3	LMF/K/H 8LUU
19	0 −16	55		40		6	29	30	25	29	–	15	4.5×8×4.4	LMF/K/H 10LUU
21		57		42		6	32	32	27	32	–	15	4.5×8×4.4	LMF/K/H 12LUU
23		61		43		6	33	34	29	33	–	15	4.5×8×4.4	LMF/K/H 13LUU
28		70		48		6	38	37	34	31	22	15	4.5×8×4.4	LMF/K/H 16LUU
32	0 −19	80		54		8	43	42	38	36	24	20	5.5×9.5×5.4	LMF/K/H 20LUU
40		112		62		8	51	50	46	40	32	20	5.5×9.5×5.4	LMF/K/H 25LUU
45		123		74		10	60	58	51	49	35	20	6.6×11×6.5	LMF/K/H 30LUU
52	0 −22	135	0 −0.4	82		10	67	64	–	–	–	25	6.6×11×6.5	LMF/K 35LUU
60		154		96	0 −0.3	13	78	75	–	–	–	25	9×14×8.6	LMF/K 40LUU
80		192		116		13	98	92	–	–	–	25	9×14×8.6	LMF/K 50LUU
90	0 −25	211		134		18	112	106	–	–	–	25	11×17.5×10.8	LMF/K 60LUU

* : the value of Circular type

Linear Bushing LMEF/K□L Series

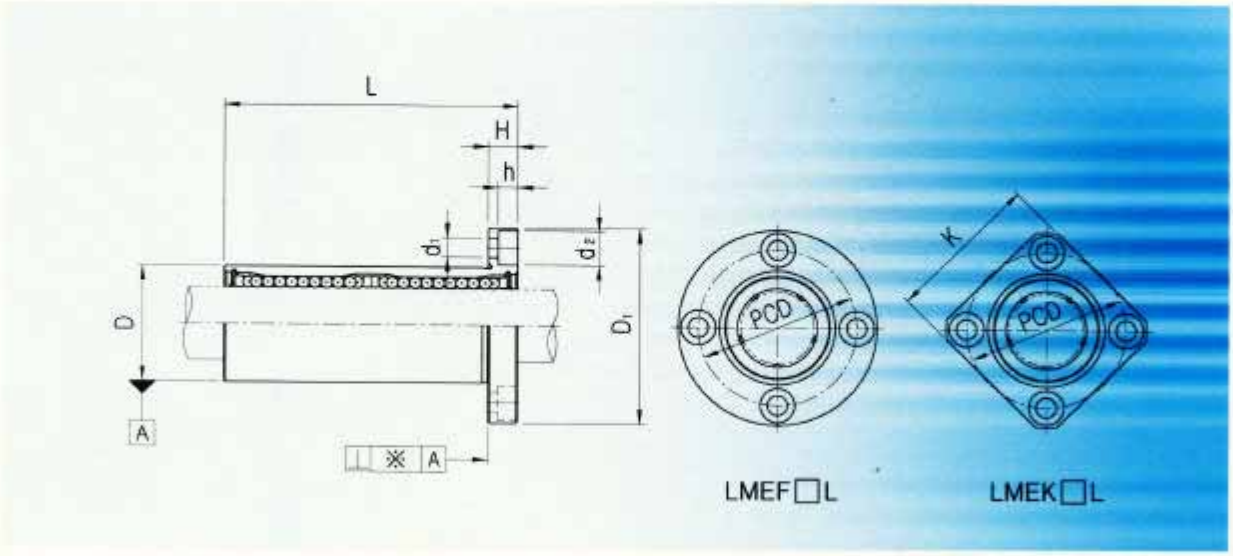
LMEF □L

LMEK □L

Part number		No. of Ball circuit	Wgt.* (gf)	Allowable Diametral Clearance (μm)	Basic Load Ratings		Working Bore Diameter	
Circular type	Square type				Dynamic C (N)	Static C_0 (N)	dr (mm)	Tol. (μm)
LMEF8LUU	LMEK8LUU	4	53	−5	430	780	8	+9 −1
LMEF12LUU	LMEK12LUU	4	100	−5	650	1200	12	
LMEF16LUU	LMEK16LUU	5	187	−7	1230	2350	16	+11 −1
LMEF20LUU	LMEK20LUU	5	260	−9	1400	2750	20	
LMEF25LUU	LMEK25LUU	6	515	−9	1560	3140	25	+13 −2
LMEF30LUU	LMEK30LUU	6	655	−9	2490	5490	30	
LMEF40LUU	LMEK40LUU	6	1560	−13	3430	8040	40	+16 −4
LMEF50LUU	LMEK50LUU	6	3500	−13	6080	15900	50	
LMEF60LUU	LMEK60LUU	6	4500	−16	7650	20000	60	

note) Plating and RAYDENT treatments are available

1N≒0.102kgf



Dimensions(mm)											Part number
D (mm)	D Tol. (μm)	L (mm)	L Tol. (mm)	D_1 (mm)	D_1 Tol. (mm)	H	PCD	K	Squareness * (μm)	$d_1 \times d_2 \times h$	
16	0 / −9	45	0 −0.3	32	0 −0.2	5	24	25	15	3.4×6.5×3.3	LMEF/K 8LUU
22	0 −11	57		42		6	32	32	15	4.5×8×4.4	LMEF/K 12LUU
26		70		46		6	36	35	15	4.5×8×4.4	LMEF/K 16LUU
32	0 −13	80		54		8	43	42	17	5.5×9.5×5.4	LMEF/K 20LUU
40		112	0 −0.4	62		8	51	50	17	5.5×9.5×5.4	LMEF/K 25LUU
47		123		76		10	62	60	17	6.6×11×6.5	LMEF/K 30LUU
62	0 −15	154		98	0 −0.3	13	80	75	20	9×14×8.6	LMEF/K 40LUU
75		192		112		13	94	88	20	9×14×8.6	LMEF/K 50LUU
90	0 −20	211		134		18	112	106	25	11×17.5×10.8	LMEF/K 60LUU

* : the value of Circular type

SAMICK LINEAR BUSHING SYSTEM

SAMICK SUPERBALL

LMES/LMBS SERIES

SAMICK Super Linear Bushing SUPERBALL Series

SAMICK offers SUPERBALL as a new standard in linear motion beainrgs. This SUPERBALL has 3 times load rating and 27 times travel life of conventional linear bushings. Also, SAMICK SUPERBALL offers Self Alingnment, which can give you less installation time and can prolong the travel life by reducing of the friction between the shaft and balls. SUPERBALL is designed to meet any customer's demands such as factory automation equipments, industrial machines, electrical equipments, measuring instruments, and etc. SAMICK SUPERBALL will give you the benefit of total cost reduction and improvement of your machine performance.

SUPERBALL Features

1. Higher load ratings

Uniquely designed ball plate is made of hardened steel, and the precisely ground groove is slightly larger than the ball size, which provides greater contact area between the ball and the ball plate. And, this design provides 3 times load ratings compared to convenentional linear bushing.

2. Self alignment

Ball plate has a convex shape to provide a pivot point at the center which allows self alignment up to 0.5°. This self alignment capability eliminates any possibility of edge pressure caused by inaccurate machining, errors on mounting, or shaft deflection.

2. Longer travel life

SUPERBALL's load ratings can be 3 times of conventional linear bushing, 27 times travel life of conventional linear bushing can be obtained.

4. Smooth and Slient motion

SUPERBALL has extremly smooth running due to the uniquely designed ball retainer and the outer sleeve. They are made of engineering polymer, which has light weight, low friction, and high wear-resistance. Due to them, the smooth and silent running can be obtained.

5. Clearance Adjustment

SUPERBALL's ball plates are designed to float in the outer sleeve. This allows clearance between the balls and shaft to be adjusted for the best application environment by using with the Clearance Adjustable housing.

6. Interchangeability

SUPERBALL is designed to be fully Interchangeable with conventional linear bushing.

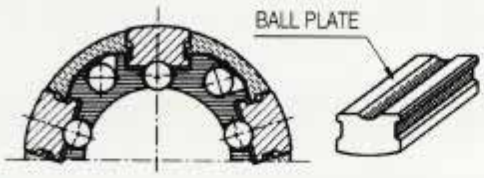


Fig 20 Cross-section of SUPERBALL

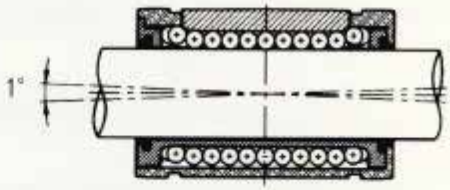


Fig 21 SUPERBALL'S self-alignment feature

Cost Effectiveness

1. Lower cost on

Self alignment feature can compensate the inaccurate machining of the base, so less installation time and cost can be obtained.

2. Higher load rating and longer travel life

Compared to the same size conventional linear bushing, SUPPERBALL will offer higher load rating and longer travel life.

3. Reduction of material cost

SUPERBALL's higher load rating enables the use of smaller components, and reducing material cost.

4. Energy saving

SUPERBALL is designed with light weight, lower inertia, and low friction, so it enables the moving parts to have rapid motion with lower driving power.

SUPERBALL types

Standard type (not sealed)

Floating designed ball plate features offer self alignment ability and clearance adjustment, and light weight retainer and outer sleeve offer silent operation.

Open type

One ball circuit has been removed from outer sleeve to be used with bottom supported shaft for deflection free movement. This open type SUPERBALL also has self alignment and clearance adjustment.

Standard type (sealed)

Special designed integral wiper seals create a free floating action in the outer sleeve. It provides perfect sealing ability during self aligning operation.

Part Number Notation

SUPERBALL's part number notation is as follows:

LM□S 25 UU OP

Model
E : ISO Standard(metric)
B : Imperial standard(inch)

LM Shaft Dia.

Seal
– : No Seal
UU : Seals on both sides

type
– : Standard type
OP : Open type

Load Ratings and Travel Life

SUPERBALL'S load ratings give an influence to travel life with load direction, ball circuit orientation, and hardness of the shaft.

Basic dynamic load rating(C) and travel life

The travel life of a SUPERBALL is determined largely by the quality of the shaft. The basic dynamic load rating is maximum continuous load that can be applied to the SUPERBALL with 90% of reliability achieving after 50km operation under normal conditons. The nominal travel life can be calculated by following equation.

$$L = [\frac{C}{P}]^3 \times 50$$

Where

L : Nominal life (*km*)
C : Basic dynamic load rating (*N*)
P : Applied load (*N*)

Practically, other factors will affect the life as follows:

$$L = [\frac{f_H}{f_W} \times \frac{C}{P}]^3 \times 50$$

Where

f_H : Hardness factor (see Fig 1)
f_W : Load factor (see Table 3)

From the above equations, the stroke and frequency are constant, the travel life can be calculated by following equation:

$$L_h = \frac{L}{2 \times Ls \times Nt \times 60}$$

Where

L_h : Nominal life (*hr*)
Ls : Stroke length (*km*)
Nt : Number of strokes per minute (*cpm*)

Calculation example

The Maximum applied load and the travel life are the most important factor for choosing a proper SUPERBALL size.
Belows are the sample calculation of the expecting travel life and choosing of proper SUPERBALL size.

- Working condition -

- Applied load : 850N (P)
- Stroke : 0.250m (Ls)
- Number of strokes per minute : 60 (Nt)
- Shaft hardness : HRC 60 ($f_H = 1.0$)
- Operating speed :

$$V = 2 \times Ls \times Nt$$
$$= 2 \times 0.250 \times 60$$
$$= 30m/min \quad (f_W = 1.6)$$

other factors (f_C, f_T) are considered as 1.0

Calculation of expected travel life

Since, basic dynamic load rating is based on travel life of 50km and assuming all other factors as 1.0, you can choose the Linear Bushing size that you can expected travel life.
Let's try LMES25UU with the above working conditions.

$$L = (\frac{1.0 \times 1.0 \times 1.0}{1.6} \times \frac{2580}{850})^3 \times 50$$
$$\fallingdotseq 341\ km$$

$$L_h = \frac{341 \times 10^3}{2 \times 0.250 \times 60 \times 60}$$
$$\fallingdotseq 189.4\ hours$$

Choosing a proper SUPERBALL

Let's assume our design travel life is 500hours;
L= 500 X 2 X 0.250 X 10-3 X 60 X 60 = 900km

$$C = \frac{850 \times 1.6}{1.0 \times 1.0 \times 1.0} \times \sqrt[3]{\frac{900}{50}}$$
$$= 3564\ N$$

So, the proper SUPERBALL for above condition is LMES25UU which has 3800N as the basic dynamic load rating.

Housing and Shaft

To optimize the performance of the SAMICK SUPERBALL, high precision shaft and housing are required.

Housing

For SUPERBALL's application, housing is required, and tolorance of housing bore will affect the life and the accuracy of application. See Table 9. 10.

Shaft

Because the balls in SAMICK SUPERBALL as rolling elements are running directly on the shaft surface, the hardness, surface finishing, and tolerance of shaft will largely affect the traveling performance of SUPERBALL.

The shaft must have following conditions:

1) Hardness

The hardness must be HRC 58 to 64.
The shaft hardness with less than HRC58 will lead decreasing of travel life and permisible load.

2) Surface Finishing

The surface finishing must be 1.6S or better for smooth operation.

3) Tolerance

The correct tolerance of the shaft diameter is recommended. See Table 9. 10.

Fitting

Recommended fittings between SUPERBALL and shaft are shown in Table 9. 10.

1) Metric type

When the housing bore tolerance is H7, there are tight fit at the both ends of outer sleeve.

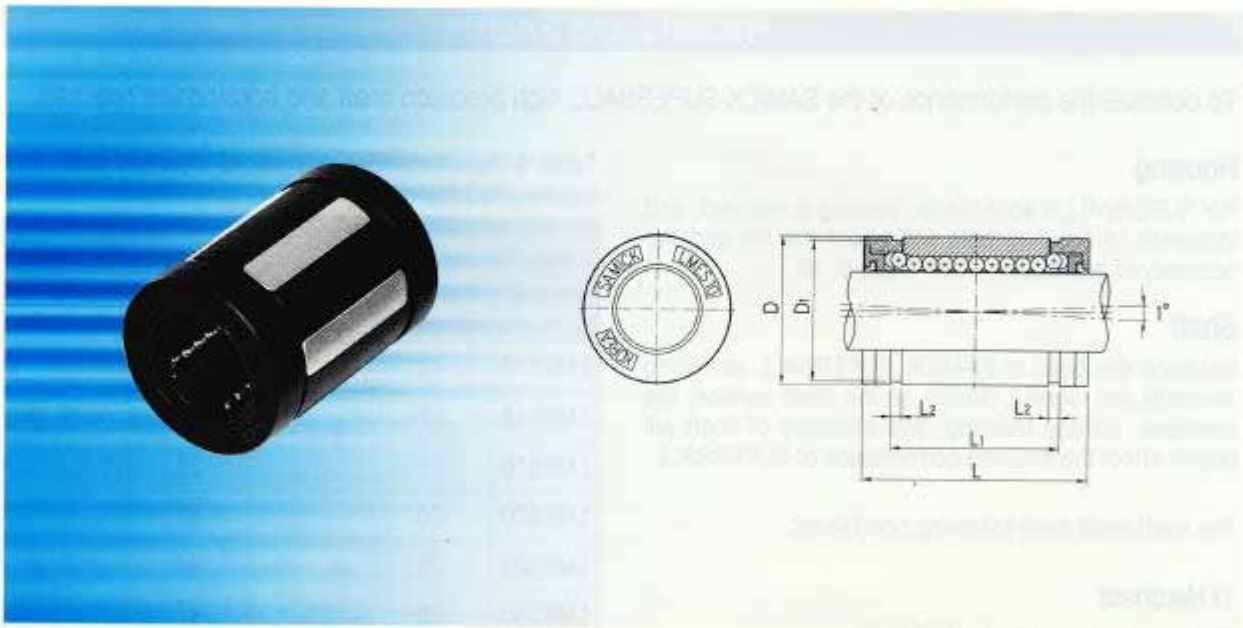
Table 9 Recommended toleranced between shaft and houshing(ISO Standard)

Part number	Shaft		Housing	
	Shaft Dia. dr(mm)	Tol. (h6) μm	Housing Bore D(mm)	Tol. (h7) μm
LMES10	10	0 −9	19	+21 0
LMES12	12	0 −11	22	
LMES16	16		26	
LMES20	20	0 −13	32	+25 0
LMES25	25		40	
LMES30	30		47	
LMES40	40	0 −16	62	+30 0
LMES50	50		75	

Table 10 Recommended toleranced between shaft and houshing(Imperial Standard) unit : inch

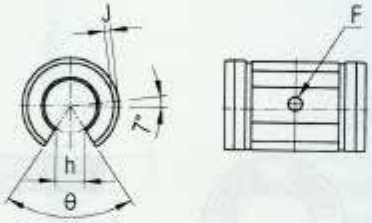
Part number	Shaft		Housing	
	Shaft Dia.	Tol. (g6)	Housing Bore	Tol. (h7)
LMBS4	.2500	-.0002 to -.0006	.5000	0 to +.0007
LMBS6	.3750	-.0002 to -.0006	.6250	0 to +.0007
LMBS8	.5000	-.0002 to -.0007	.8750	0 to +.0008
LMBS10	.6250	-.0002 to -.0007	1.1250	0 to +.0008
LMBS12	.7500	-.0003 to -.0008	1.2500	0 to +.0010
LMBS16	1.0000	-.0003 to -.0008	1.5625	0 to +.0010
LMBS20	1.2500	-.0004 to -.0010	2.0000	0 to +.0012
LMBS24	1.5000	-.0004 to -.0010	2.3750	0 to +.0012
LMBS32	2.0000	-.0004 to -.0012	3.0000	0 to +.0012

SAMICK SUPERBALL LMES Series

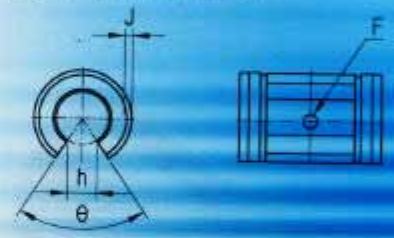


Shaft Dia. (mm)	Standard Type				Dimensions(mm)					Diametral Clearance	Basic Load Ratings	
	Part number		No. of Ball circuit	Wgt. (g)	D	D_1	L ±0.2	L_1 ±0.2	L_2 min	H7/h6 (μm)	Dynamic C (N)	Static C_o (N)
	w/o seal	with seal										
10	LMES10	LMES10UU	5	17	19	18	29	21.7	1.35	0~+38	750	550
12	LMES12	LMES12UU	5	23	22	21	32	22.7	1.35	0~+40	1230	1100
16	LMES16	LMES16UU	5	28	26	24.9	36	24.7	1.35	-1~+41	1550	1250
20	LMES20	LMES20UU	6	61	32	30.3	45	31.3	1.65	-1~+47	2580	1670
25	LMES25	LMES25UU	6	122	40	38	58	43.8	1.90	-1~+49	3800	2750
30	LMES30	LMES30UU	6	185	47	45.5	68	51.8	1.90		4710	2800
40	LMES40	LMES40UU	6	360	62	59	80	60.4	2.20	-2~+59	6500	5720
50	LMES50	LMES50UU	6	580	75	72	100	77.4	2.70		11460	7940

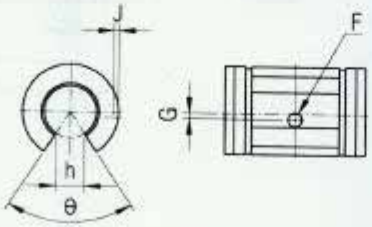
LMES12-OP



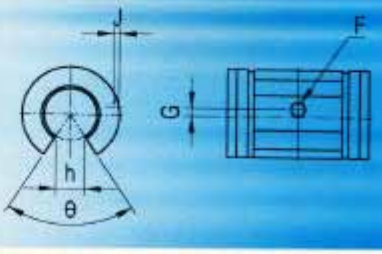
LMES16-OP, LMES20-OP,



LMES25-OP

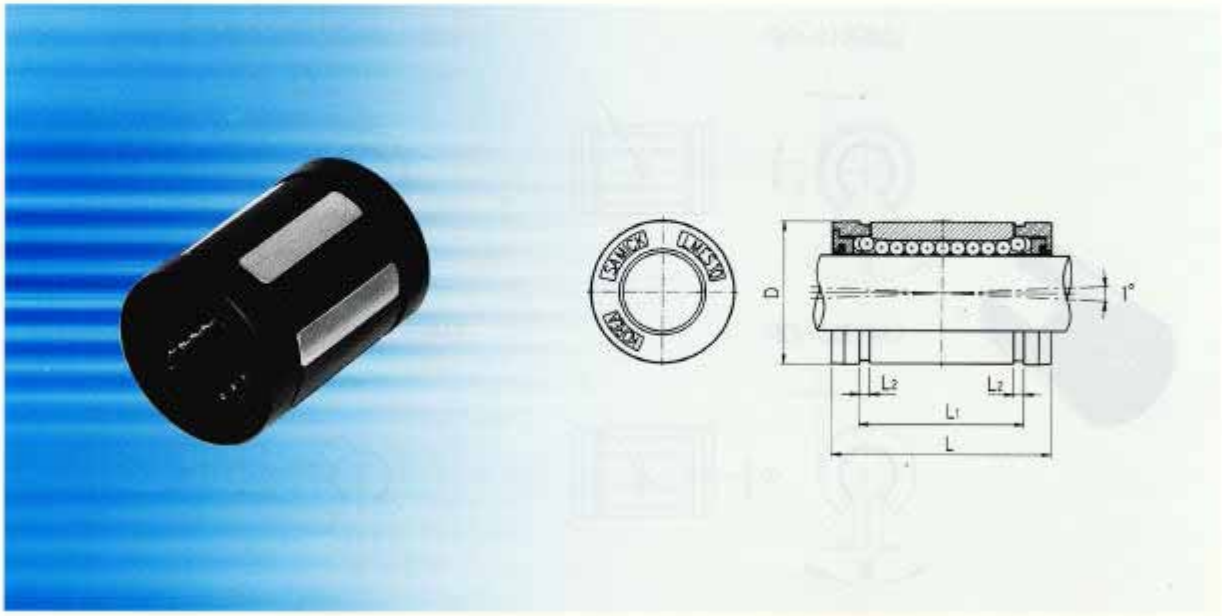


LMES30-OP, LMES40-OP, LMES50-OP



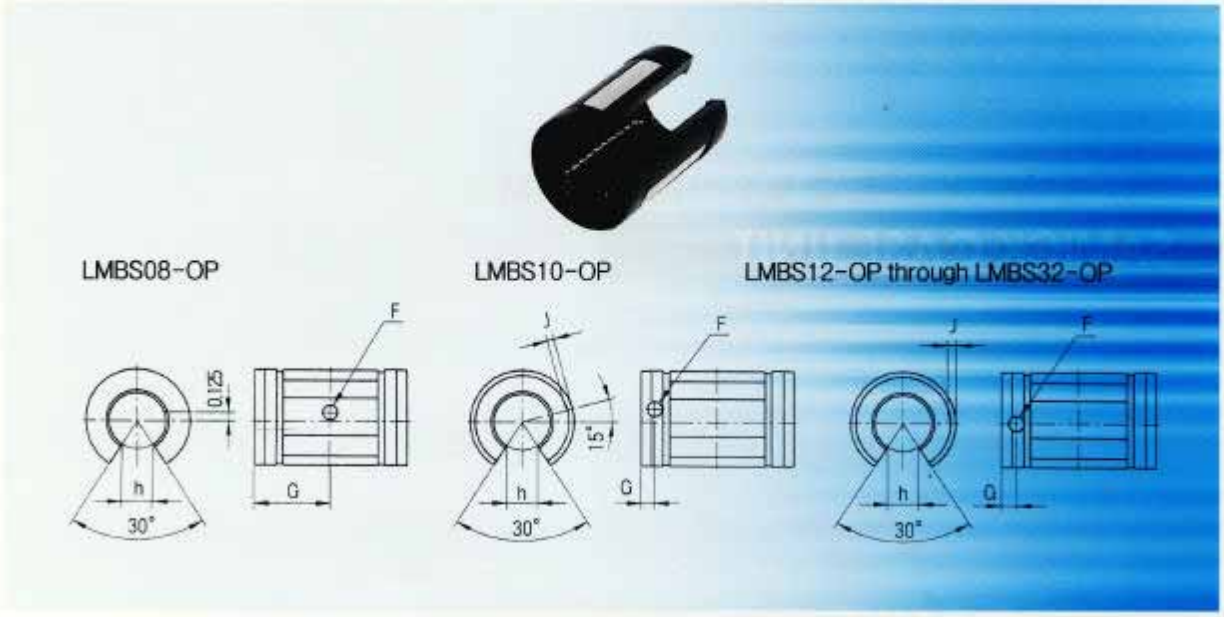
Shaft Dia. (mm)	Open Type				Dimensions(mm)								Basic Load Ratings	
	Part number		No. of Ball circuit	Wgt. (g)	D	L ±0.2	L_2 min	h	θ (°)	F	G	J	Dynamic C (N)	Static C_0 (N)
	w/o seal	with seal												
12	LMES12OP	LMES12UUOP	4	18	22	32	1.35	6.5	66		–	0.7	1290	1260
16	LMES16OP	LMES16UUOP	4	22	26	36	1.35	9	68		–	0.7	1640	1320
20	LMES20OP	LMES20UUOP	5	51	32	45	1.65	9	55		–	0.9	2630	1720
25	LMES25OP	LMES25UUOP	5	102	40	58	1.90	11.5	57	3.0	1.5	1.4	3910	2850
30	LMES30OP	LMES30UUOP	5	155	47	68	1.90	14	57		2.0	2.2	4850	2900
40	LMES40OP	LMES40UUOP	5	300	62	80	2.20	19.5	56		1.5	2.7	6700	5900
50	LMES50OP	LMES50UUOP	5	480	75	100	2.70	22.5	54		2.5	2.3	11700	8100

SAMICK SUPERBALL LMBS Series



Shaft Dia. (inch)	Standard Type				Dimensions (inch)				Basic Load Ratings	
	Part number		No. of Ball circuit	Wgt. (lb)	D[1]	L	L_1	L_2 min	Dynamic C (lbf)	Static C_0 (lbf)
	w/o seal	with seal								
1/4	LMBS4	LMBS4UU	4	0.01	0.5000	0.750/0.735	0.511/0.501	0.039	57	49
3/8	LMBS6	LMBS6UU	4	0.02	0.6250	0.875/0.860	0.699/0.689	0.039	78	66
1/2	LMBS8	LMBS8UU	4	0.05	0.8750	1.250/1.230	1.032/1.012	0.050	190	190
5/8	LMBS10	LMBS10UU	5	0.08	1.1250	1.500/1.480	1.105/1.095	0.056	290	340
3/4	LMBS12	LMBS12UU	6	0.14	1.2500	1.625/1.605	1.270/1.250	0.056	500	430
1	LMBS16	LMBS16UU	6	0.29	1.5625	2.250/2.230	1.884/1.864	0.070	820	780
1-1/4	LMBS20	LMBS20UU	6	0.40	2.0000	2.625/2.600	2.004/1.984	0.068	1240	1270
1-1/2	LMBS24	LMBS24UU	6	0.80	2.3750	3.000/2.970	2.410/2.390	0.086	1510	1540
2	LMBS32	LMBS32UU	6	1.38	3.0000	4.000/3.960	3.193/3.163	0.105	2230	2580

[1] Norminal Outer Diameter



Shaft Dia. (inch)	Standard Type				Dimensions (inch)							Basic Load Ratings	
	Part number		No. of Ball circuit	Wgt. (lb)	D[1]	L	F	G	J	L2 min	h	Dynamic C (lbf)	Static C0 (lbf)
	w/o seal	with seal											
1/2	LMBS8OP	LMBS8UUOP	3	0.03	0.8750	1.250/1.230	0.14	0.63	Thru	0.050	0.32	210	190
5/8	LMBS10OP	LMBS10UUOP	4	0.06	1.1250	1.500/1.480	0.11	0.13	0.039	0.056	0.38	320	340
3/4	LMBS12OP	LMBS12UUOP	5	0.11	1.2500	1.625/1.605	0.14	0.13	0.059	0.056	0.43	510	430
1	LMBS16OP	LMBS16UUOP	5	0.21	1.5625	2.250/2.230	0.14	0.13	0.047	0.070	0.56	830	780
1-1/4	LMBS20OP	LMBS20UUOP	5	0.35	2.0000	2.625/2.600	0.20	0.19	0.090	0.068	0.63	1250	1270
1-1/2	LMBS24OP	LMBS24UUOP	5	0.67	2.3750	3.000/2.970	0.20	0.19	0.090	0.086	0.75	1520	1540
2	LMBS32OP	LMBS32UUOP	5	1.10	3.0000	4.000/3.960	0.27	0.31	Thru	0.105	1.00	2250	2580

[1] Norminal Outer Diameter

SAMICK LINEAR BUSHING SYSTEM

SAMICK CASE UNIT

SAMICK Linear Bushing Case Unit

SAMICK offer various type of Linear Bushing Case Unit for designing of linear motion system. Precisely machined Aluminum Cases are standarized for providing Interchangeablity and less cost and less designing time.

Case Unit

The case is compact and light weight, and the standard type Linear Bushing is assembled inside.

● SC(E) type

Standard type aluminum Case Unit.
Simple mounting with mounting bolt to the table.

● SC(E)□W type

Double standard type Linear Bushing assembled type aluminum Case Unit.

● SC(E)□V type

Short type aluminum Case Unit with a standard type Linear Bushing.
More compact design than SC(E) type is available.

● SCJ type

Clearance adjustable type aluminum Case Unit by slotting in axial direction.
If high precise positioning is required, SCJ type can minimize the effect of clearnace between shaft and case.

* assembled Linear Bushing is orientated to have maximum load rating against top of Case Unit.

★SCE, SCE□W, SCE□V type are for European user

Part Number Notation

SC□ 20□UU(N)

Case Unit

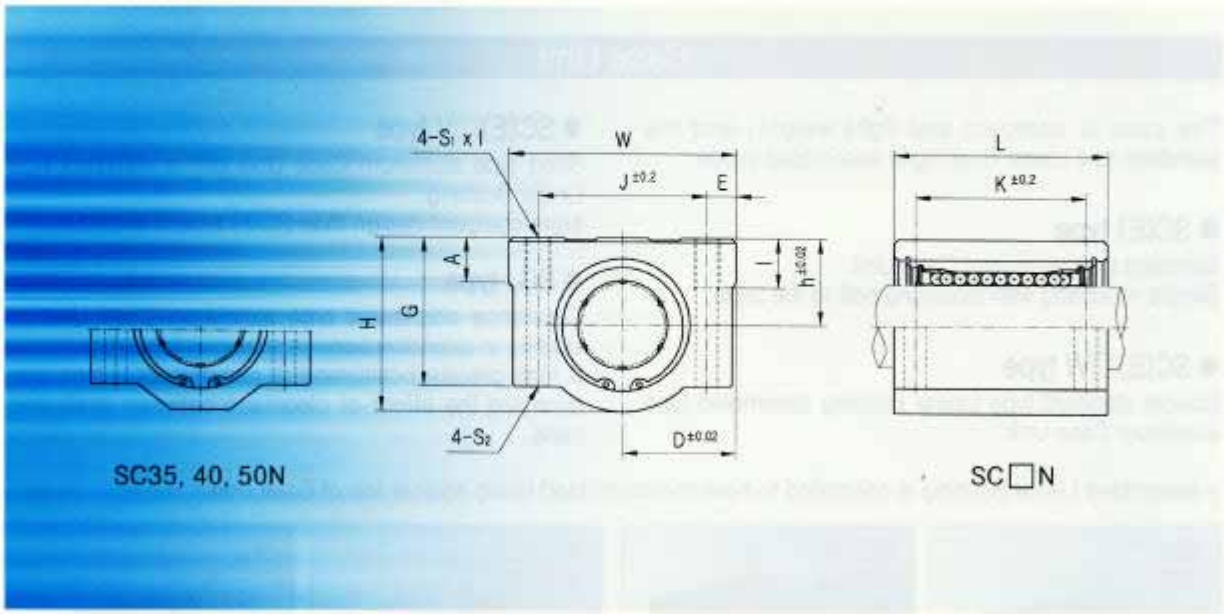
Model
– : Asian standard type
E : European type
J : Clearance adjustable type

LM Shaft Dia.

Seal
– – : No seal
UU : Seals on both sides

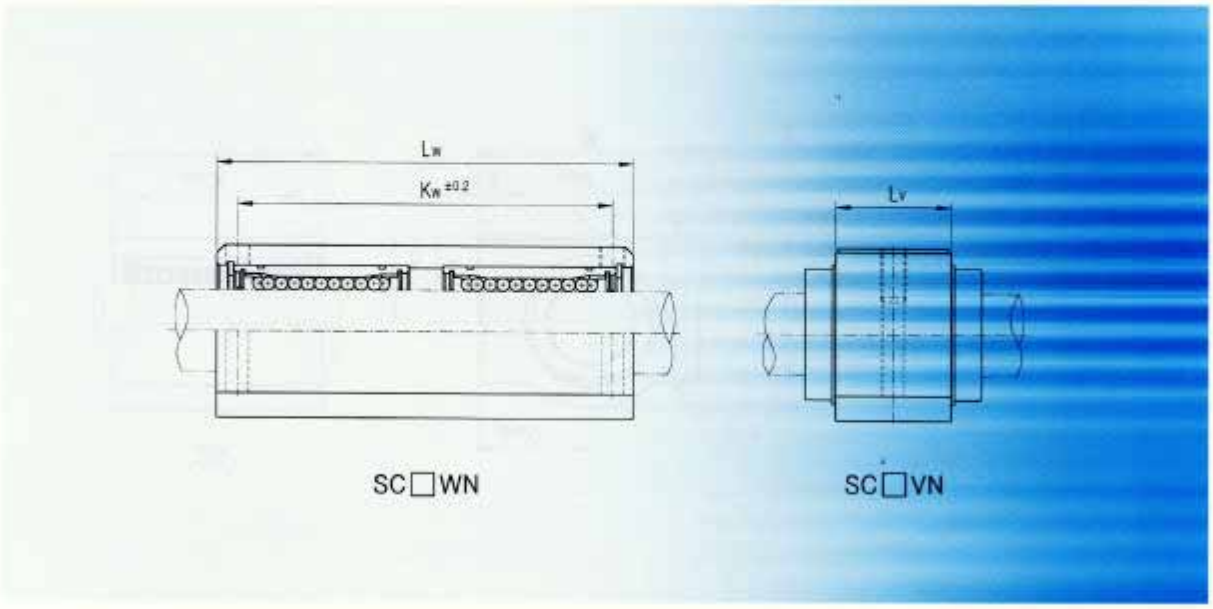
Type
– : Standard type
W : Long type
V : Short type

Linear Bushing Case Unit SC Series



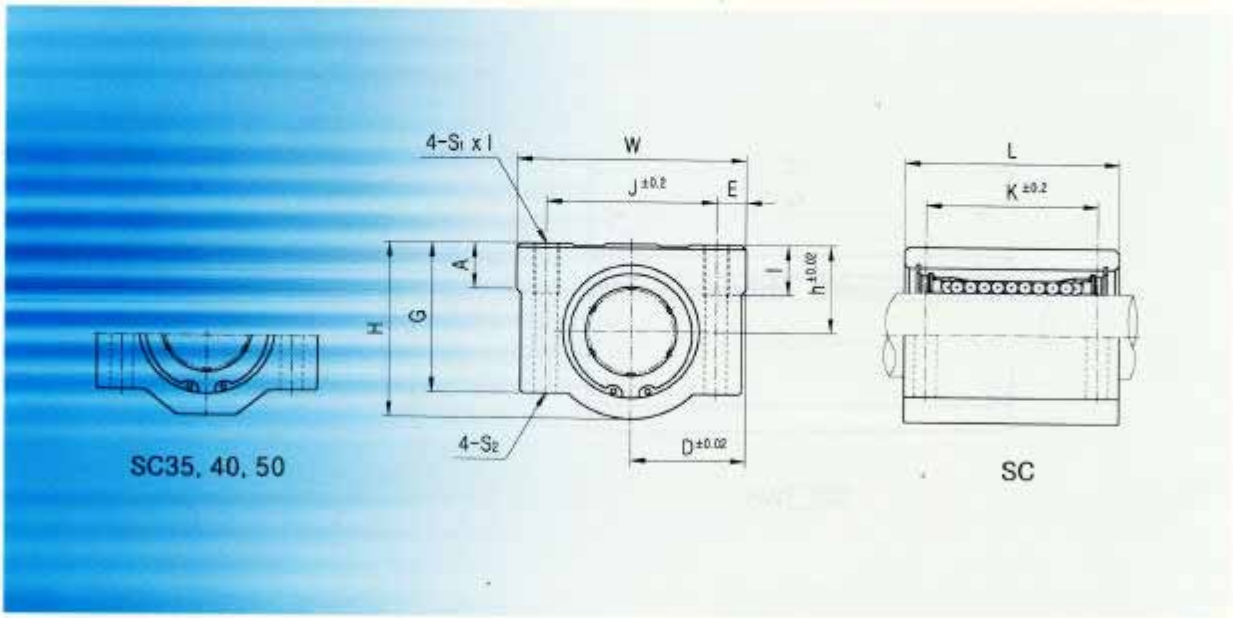
Standard Type					Long Type					Short Type				
Part number	Installed L/B	Load Ratings C(N)	Load Ratings C0(N)	Wgt. (g1)	Part number	Installed L/B	Load Ratings C(N)	Load Ratings C0(N)	Wgt. (g1)	Part number	Installed L/B	Load Ratings C(N)	Load Ratings C0(N)	Wgt. (g1)
SC8UUN	LM8UU	260	400	56	SC8WUUN	2×LM8UU	410	800	94	SC8VUUN	LM8UU	260	400	36
SC10UUN	LM10UU	370	540	90	SC10WUUN	2×LM10UU	590	1080	147	SC10VUUN	LM10UU	370	540	63
SC12UUN	LM12UU	410	590	112	SC12WUUN	2×LM12UU	650	1180	220	SC12VUUN	LM12UU	410	590	74
SC13UUN	LM13UU	500	770	123	SC13WUUN	2×LM13UU	800	1540	245	SC13VUUN	LM13UU	500	770	85
SC16UUN	LM16UU	770	1170	189	SC16WUUN	2×LM16UU	1230	2340	376	SC16VUUN	LM16UU	770	1170	132
SC20UUN	LM20UU	860	1370	237	SC20WUUN	2×LM20UU	1370	2740	476	SC20VUUN	LM20UU	860	1370	170
SC25UUN	LM25UU	980	1560	555	SC25WUUN	2×LM25UU	1560	3120	1115	SC25VUUN	LM25UU	980	1560	405
SC30UUN	LM30UU	1560	2740	685	SC30WUUN	2×LM30UU	2490	5480	1375	SC30VUUN	LM30UU	1560	2740	495
SC35UUN	LM35UU	1660	3130	1100	SC35WUUN	2×LM35UU	2650	6260	2200	SC35VUUN	LM35UU	1660	3130	790
SC40UUN	LM40UU	2150	4010	1600	SC40WUUN	2×LM40UU	3440	8020	3200	SC40VUUN	LM40UU	2150	4010	1220
SC50UUN	LM50UU	3820	7930	3350	SC50WUUN	2×LM50UU	6110	15860	6720	SC50VUUN	LM50UU	3820	7930	2300

1N≒0.102kgf



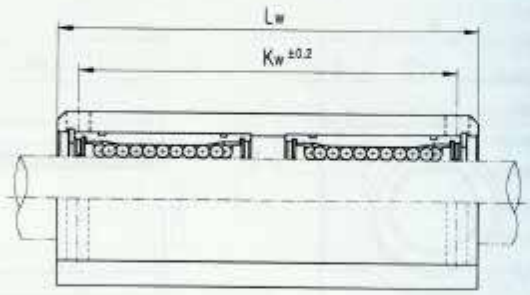
Shaft Dia.	Dimensions(mm)																Part number
	Common										SC		SC□W		SC□V		
	h	D	W	H	G	A	J	E	S1×l	S2	K	L	Kw	Lw	Lv		
ø 8	11	17	34	22	18	6	24	5	M4×8	ø 3.4	18	30	42	58	15.4		SC8UUN
ø 10	13	20	40	26	21	8	28	6	M5×12	ø 4.3	21	35	46	68	19.5		SC10UUN
ø 12	15	21	42	28	24	7.4	30.5	5.75	M5×12	ø 4.3	26	36	50	70	20.5		SC12UUN
ø 13	15	22	44	30	24.5	8	33	5.5	M5×12	ø 4.3	26	39	50	75	20.5		SC13UUN
ø 16	19	25	50	38.5	32.5	9	36	7	M5×12	ø 4.3	34	44	60	85	23.5		SC16UUN
ø 20	21	27	54	41	35	11	40	7	M6×12	ø 5.2	40	50	70	96	27.4		SC20UUN
ø 25	26	38	76	51.5	41	12	54	11	M8×18	ø 6.8	50	67	100	130	37.4		SC25UUN
ø 30	30	39	78	59.5	49	15	58	10	M8×18	ø 6.8	58	72	110	140	40.9		SC30UUN
ø 35	34	45	90	68	54	18	70	10	M8×18	ø 6.8	60	80	120	155	45.4		SC35UUN
ø 40	40	51	102	78	62	20	80	11	M10×25	ø 8.6	60	90	140	175	56.4		SC40UUN
ø 50	52	61	122	102	80	24	100	11	M10×25	ø 8.6	80	110	160	215	68.9		SC50UUN

Linear Bushing Case Unit SC Series

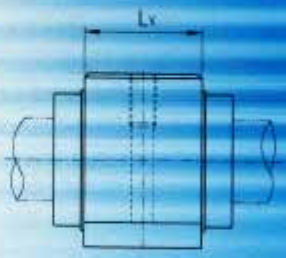


Standard Type					Long Type					Short Type				
Part number	Installed L/B	Load Ratings C(N)	Load Ratings C0(N)	Wgt. (gf)	Part number	Installed L/B	Load Ratings C(N)	Load Ratings C0(N)	Wgt. (gf)	Part number	Installed L/B	Load Ratings C(N)	Load Ratings C0(N)	Wgt. (gf)
SC8UU	LM8UU	260	400	56	SC8WUU	2×LM8UU	410	800	94	SC8VUU	LM8UU	260	400	36
SC10UU	LM10UU	370	540	90	SC10WUU	2×LM10UU	590	1080	147	SC10VUU	LM10UU	370	540	63
SC12UU	LM12UU	410	590	112	SC12WUU	2×LM12UU	650	1180	220	SC12VUU	LM12UU	410	590	74
SC13UU	LM13UU	500	770	123	SC13WUU	2×LM13UU	800	1540	245	SC13VUU	LM13UU	500	770	85
SC16UU	LM16UU	770	1170	189	SC16WUU	2×LM16UU	1230	2340	376	SC16VUU	LM16UU	770	1170	132
SC20UU	LM20UU	860	1370	237	SC20WUU	2×LM20UU	1370	2740	476	SC20VUU	LM20UU	860	1370	170
SC25UU	LM25UU	980	1560	555	SC25WUU	2×LM25UU	1560	3120	1115	SC25VUU	LM25UU	980	1560	405
SC30UU	LM30UU	1560	2740	685	SC30WUU	2×LM30UU	2490	5480	1375	SC30VUU	LM30UU	1560	2740	495
SC35UU	LM35UU	1660	3130	1100	SC35WUU	2×LM35UU	2650	6260	2200	SC35VUU	LM35UU	1660	3130	790
SC40UU	LM40UU	2150	4010	1600	SC40WUU	2×LM40UU	3440	8020	3200	SC40VUU	LM40UU	2150	4010	1220
SC50UU	LM50UU	3820	7930	3350	SC50WUU	2×LM50UU	6110	15860	6720	SC50VUU	LM50UU	3820	7930	2300

1N≒0.102kgf



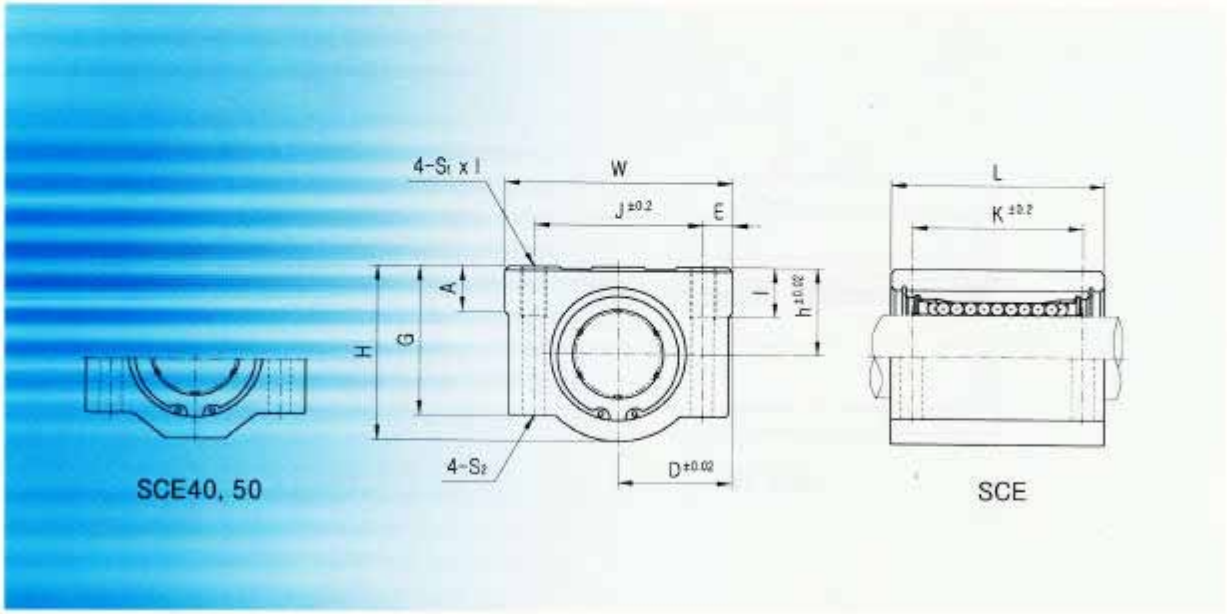
SC □W



SC □V

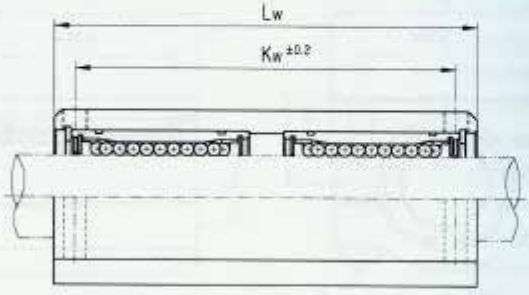
Shaft Dia.	Dimensions(mm)															Part number
	Common										SCE		SCE□W		SC□V	
	h	D	W	H	G	A	J	E	$S_1 \times l$	S_2	K	L	Kw	Lw	Lv	
ø 8	11	17	34	22	18	6	24	5	M4×8	ø 3.4	18	30	42	58	15.4	SC8UU
ø 10	13	20	40	26	21	8	28	6	M5×10	ø 4.3	21	35	46	68	19.5	SC10UU
ø 12	15	22	44	30	24.5	8	33	5.5	M5×10	ø 4.3	26	39	64	77	20.5	SC12UU
ø 13	15	22	44	30	24.5	8	33	5.5	M5×10	ø 4.3	26	39	64	77	20.5	SC13UU
ø 16	19	25	50	38.5	32.5	9	36	7	M5×12	ø 4.3	34	44	79	89	23.5	SC16UU
ø 20	21	27	54	41	35	11	40	7	M6×12	ø 5.2	40	50	90	100	27.4	SC20UU
ø 25	26	38	76	51.5	41	12	54	11	M8×18	ø 6.8	50	67	119	136	37.4	SC25UU
ø 30	30	39	78	59.5	49	15	58	10	M8×18	ø 6.8	58	72	132	146	40.9	SC30UU
ø 35	34	45	90	68	54	18	70	10	M8×18	ø 6.8	60	80	140	160	45.4	SC35UU
ø 40	40	51	102	78	62	20	80	11	M10×25	ø 8.6	60	90	150	180	56.4	SC40UU
ø 50	52	61	122	102	80	24	100	11	M10×25	ø 8.6	80	110	200	230	68.9	SC50UU

Linear Bushing Case Unit SCE Series

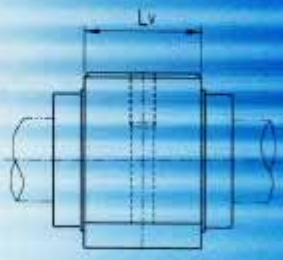


Standard Type					Long Type					Short Type				
Part number	Installed L/B	Load Ratings		Wgt. (gf)	Part number	Installed L/B	Load Ratings		Wgt. (gf)	Part number	Installed L/B	Load Ratings		Wgt. (gf)
		C0(N)	C(N)				C0(N)	C(N)				C0(N)	C(N)	
SCE8UU	LME8UU	260	400	60	SCE8WUU	2×LME8UU	410	800	98	SCE8VUU	LME8UU	260	400	40
SCE12UU	LME12UU	410	590	118	SCE12WUU	2×LMEI2UU	650	1180	232	SCE12VUU	LME12UU	410	590	82
SCE16UU	LME16UU	770	1170	180	SCE16WUU	2×LME16UU	1230	2340	360	SCE16VUU	LME16UU	770	1170	122
SCE20UU	LME20UU	860	1370	245	SCE20WUU	2×LME20UU	1370	2740	490	SCE20VUU	LME20UU	860	1370	176
SCE25UU	LME25UU	980	1560	550	SCE25WUU	2×LME25UU	1560	3120	1100	SCE25VUU	LME25UU	980	1560	400
SCE30UU	LME30UU	1560	2740	760	SCE30WUU	2×LME30UU	2490	5480	1525	SCE30VUU	LME30UU	1560	2740	570
SCE40UU	LME40UU	2150	4010	1700	SCE40WUU	2×LME40UU	3440	8020	3400	SCE40VUU	LME40UU	2150	4010	1320
SCE50UU	LME50UU	3820	7930	2950	SCE50WUU	2×LME50UU	6110	15860	5920	SCE50VUU	LME50UU	3820	7930	1900

1N≒0.102kgf



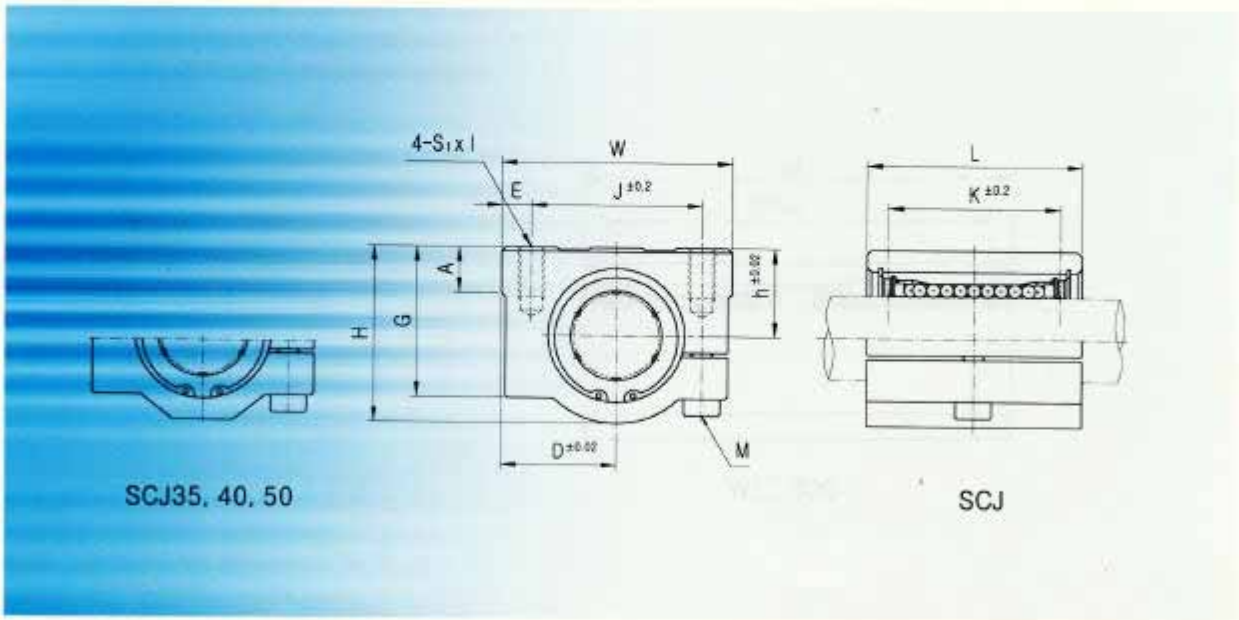
SCE □W



SCE □V

Shaft Dia.	Dimensions(mm)															Part number
	Common										SCE		SCE□W		SC□V	
	h	D	W	H	G	A	J	E	S1×l	S2	K	L	Kw	Lw	Lv	
ø8	11	17	34	22	18	6	24	5	M4×8	ø3.4	18	30	42	58	14.4	SCE8UU
ø12	15	22	44	30	24.5	8	33	5.5	M5×10	ø4.3	26	39	64	77	20.3	SCE12UU
ø16	19	25	50	38.5	32.5	9	36	7	M5×12	ø4.3	34	44	79	89	22.3	SCE16UU
ø20	21	27	54	41	35	11	40	7	M6×12	ø5.2	40	53	90	106	28.3	SCE20UU
ø25	26	38	76	51.5	41	12	54	11	M8×18	ø6.8	50	67	119	136	40.4	SCE25UU
ø30	30	39	78	59.5	49	15	58	10	M8×18	ø6.8	58	76	132	154	48.4	SCE30UU
ø40	40	51	102	78	62	20	80	11	M10×25	ø8.6	60	90	150	180	56.4	SCE40UU
ø50	52	61	122	102	80	24	100	11	M10×25	ø8.6	80	110	200	230	72.3	SCE50UU

Linear Bushing Case Unit SCJ Series



Part number	Installed L/B	Load Ratings		Shaft Dia.	Dimensions(mm)												Wgt. (g≈)
		C(N)	C0(N)		h	D	W	H	G	A	J	E	S1×l	K	L	M	
SCJ10UU	LM10UUAJ	370	540	ø10	13	20	40	26	21	8	28	6	M5×12	21	35	M4	90
SCJ12UU	LM12UUAJ	410	590	ø12	15	21	42	28	24	7.4	30.5	5.75	M5×12	26	36	M4	112
SCJ13UU	LM13UUAJ	500	770	ø13	15	22	44	30	24.5	8	33	5.5	M5×12	26	39	M4	123
SCJ16UU	LM16UUAJ	770	1170	ø16	19	25	50	38.5	32.5	9	36	7	M5×12	34	44	M4	189
SCJ20UU	LM20UUAJ	860	1370	ø20	21	27	54	41	35	11	40	7	M6×12	40	50	M5	237
SCJ25UU	LM25UUAJ	980	1560	ø25	26	38	76	51.5	41	12	54	11	M8×18	50	67	M6	555
SCJ30UU	LM30UUAJ	1560	2740	ø30	30	39	78	59.5	49	15	58	10	M8×18	58	72	M6	685
SCJ35UU	LM35UUAJ	1660	3130	ø35	34	45	90	68	54	18	70	10	M8×18	60	80	M6	1100
SCJ40UU	LM40UUAJ	2150	4010	ø40	40	51	102	78	62	20	80	11	M10×25	60	90	M8	1600
SCJ50UU	LM50UUAJ	3820	7930	ø50	52	61	122	102	80	24	100	11	M10×25	80	110	M8	3350

SAMICK LINEAR BUSHING SYSTEM

SAMICK SUPPORT RAIL UNIT

Support Rail Unit

SAMICK Support Rail Unitis composed of Support Rail, LM Shaft, and Open type Linear Bushing installed Case. All components are standarized for providing Interchangeablity and less cost and less designing time.

Supprot Rail (SBS, TBS)

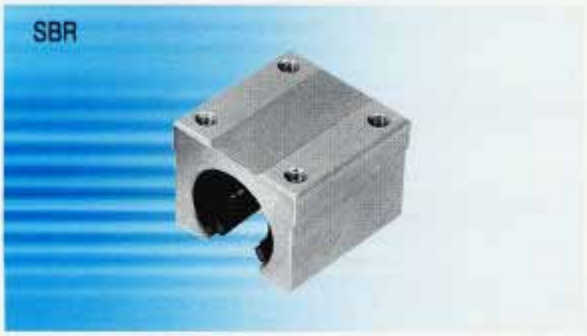
Support Rail provide maximum rigidity and stiffness to the shaft throughout the whole stroke, and ensure the performance of the unit.

Case (SBR, TBR)

Effective for High load or long stroke application with maximum rigidity and excelent motion in combination with Open type Linear Bushing, and preload can be applied on TBR series for high precision performance.

Support Rail Unit (SBR-S, TBR-S)

SBR-S and TBR-S type is optimum guide unit for high precision sliding system with smooth motion and maximum rigidity, and less cost and less designing time.



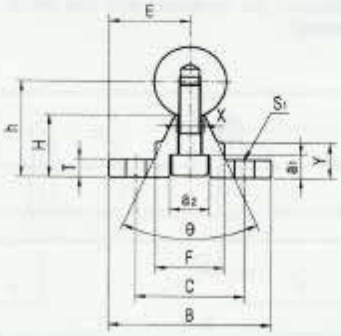
Support Rail Unit SBS Series

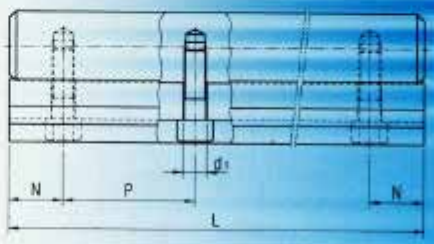
Part Number Notation

SB □ □A -1000L

- Support Rail for SBR Unit
- Shaft
  S : Shaft include
  − : Shaft not include
- LM Shaft Dia.
- Support Rail Length*

* Standard lengths are recommended the table below. Drawing should be received with the order for customer design.





Part number	Shaft Dia.	Dimensions(mm)														Wgt. (kg/m)
		E	h	B	H	T	F	X	Y	C	θ	S1	a1	a2	d1	
SBS16A	ø16	20	25	40	17.8	5	18.5	8	11.7	30	80°	ø5.5	6	9.5	5.5	2.56
SBS20A	ø20	22.5	27	45	17.7	5	19	8	10	30	50°	ø5.5	6.5	11	6.6	3.50
SBS25A	ø25	27.5	33	55	21	6	21.5	8	12	35	50°	ø6.6	6.5	11	6.6	5.30
SBS30A	ø30	30	37	60	22.8	7	26.5	10.3	13	40	50°	ø6.6	8.5	14	9	7.38
SBS35A	ø35	32.5	43	65	26.6	8	28	13	15.5	45	50°	ø9	8.5	14	9	9.68
SBS40A	ø40	37.5	48	75	29.4	9	38	16	17	55	50°	ø9	8.5	14	9	12.69
SBS50A	ø50	47.5	62	95	38.8	11	45	20	21	70	50°	ø11	12.5	19	11	20.46

Standard Length of Support Rail and Dimensions

Part number	SBS16A	SBS20A	SBS25A	SBS30A	SBS35A	SBS40A	SBS50A
Standard Length(L)	190 340 640 940	340 640 940 1240	250 450 850 1250	450 850 1250 1450	460 660 860 1060	460 660 860 1060 1260	470 670 870 1070 1270
N	20	20	25	25	30	30	35
Pitch(P)	150	150	200	200	200	200	200
Max. Length	1390	1390	1850	1850	1860	1860	2070

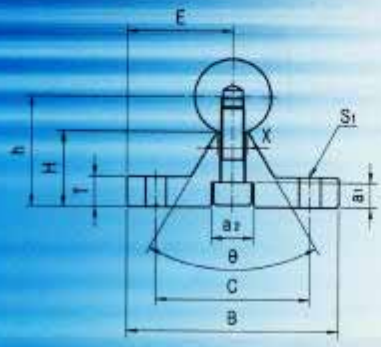
Support Rail Unit TBS Series

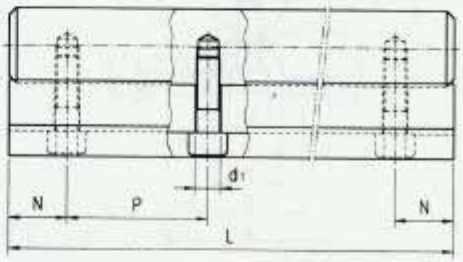
Part Number Notation

TB □ □A-1000L

- Support Rail for TBR Unit
- Shaft
  - S : Shaft include
  - – : Shaft not include
- LM Shaft Dia.
- Support Rail Length*

* Standard lengths are recommended the table below. Drawing should be received with the order for customer design.





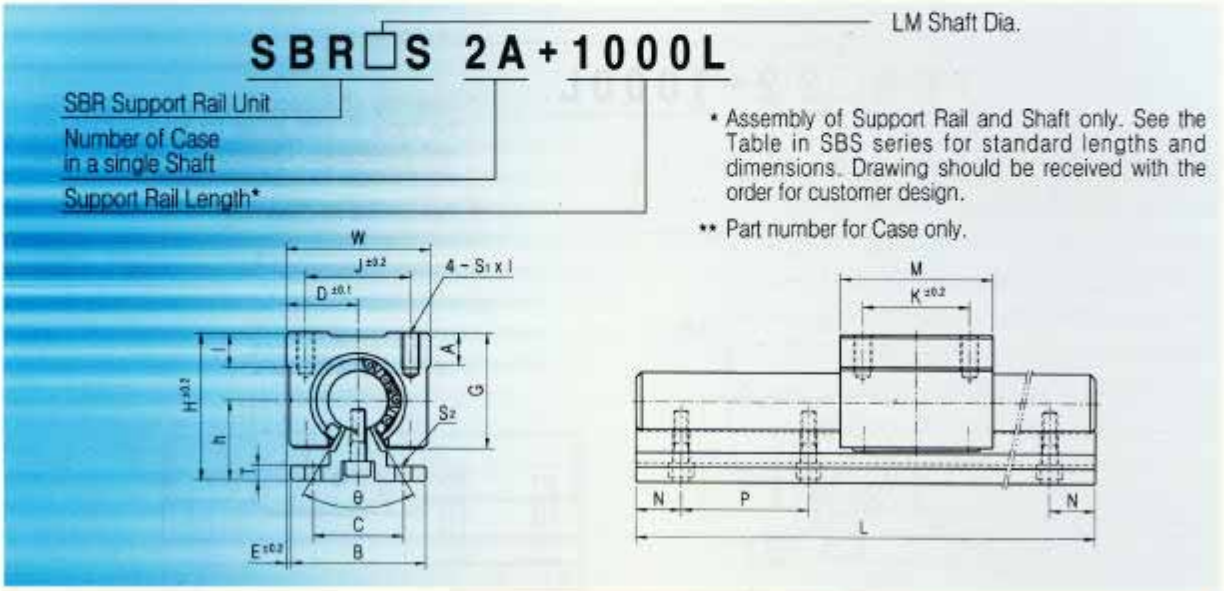
Part number	Shaft Dia.	Dimensions(mm)												Wgt. (kg/m)
		E	h	B	H	T	X	C	θ	S_1	a_1	a_2	d_1	
TBS16A	ø16	25	22	50	14.84	6	8	37	60°	ø5.5	6	9.5	5.5	2.66
TBS20A	ø20	27.5	29	55	19.64	8	8	40	50°	ø5.5	6.5	11	6.6	4.23
TBS25A	ø25	32.5	32	65	20	10	8	45	50°	ø6.6	6.5	11	6.6	5.85
TBS30A	ø30	37.5	36.5	75	22.28	12	10.3	55	50°	ø6.6	8.5	14	9	8.28

Standard Length of Support Rail and Dimensions

Part number	TBS16A	TBS20A	TBS25A	TBS30A
Standard Length(L)	190 340 640 940	340 640 940 1240	250 450 850 1250	450 850 1250 1450
N	20	20	25	25
Pitch(P)	150	150	200	200
Max. Length	1390	1390	1850	1850

Support Rail Unit SBR□S Series

Part Number Notation



Part number		Shaft Dia.	Basic Load Ratings		Weight		Dimensions(mm)				
Unit	Case**		Dynamic C(N)	Static C_0(N)	Case (kg)	Rail (kg/m)	D	h	H	E	θ
SBR16SA	SBR16UUA	ϕ16	770	1170	0.15	2.55	22.5	25	45	2.5	80°
SBR20SA	SBR20UUA	ϕ20	860	1370	0.20	3.50	24	27	50	1.5	60°
SBR25SA	SBR25UUA	ϕ25	980	1560	0.45	5.30	30	33	60	2.5	50°
SBR30SA	SBR30UUA	ϕ30	1560	2740	0.63	7.40	35	37	70	5	50°
SBR35SA	SBR35UUA	ϕ35	1660	3130	0.92	10.05	40	43	80	7.5	50°
SBR40SA	SBR40UUA	ϕ40	2150	4010	1.33	13.10	45	48	90	7.5	50°
SBR50SA	SBR50UUA	ϕ50	3820	7930	3.00	20.65	60	62	115	12.5	50°

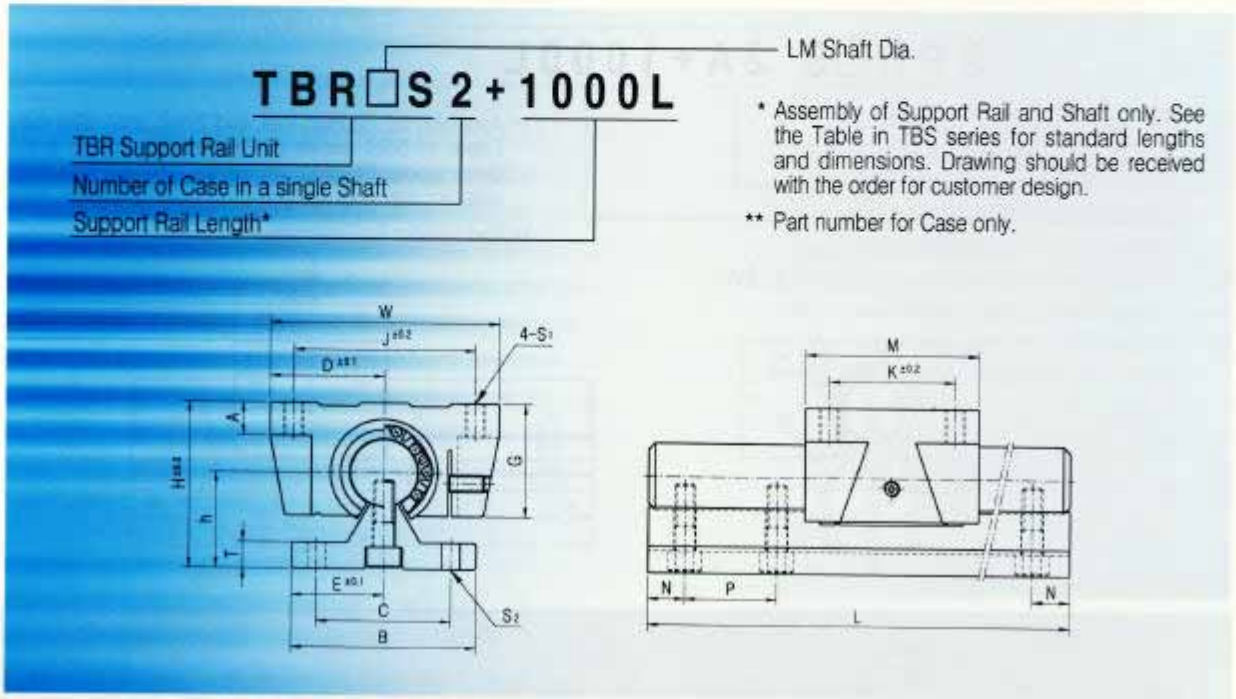
Part number	Dimensions(mm)												
	W	G	A	B	T	M	S_1×l	J	K	S_2	C	N*	P*
SBR16SA	45	33	9	40	5	45	M5×12	32	30	ϕ5.5	30	20	150
SBR20SA	48	39	11	45	5	50	M6×12	35	35	ϕ5.5	30	20	150
SBR25SA	60	47	14	55	6	65	M6×12	40	40	ϕ6.6	35	25	200
SBR30SA	70	56	15	60	7	70	M8×18	50	50	ϕ6.6	40	25	200
SBR35SA	80	63	18	65	8	80	M8×18	55	55	ϕ9	45	30	200
SBR40SA	90	72	20	75	9	90	M10×20	65	65	ϕ9	55	30	200
SBR50SA	120	91	25	95	11	110	M10×20	94	80	ϕ11	70	35	200

*: Standard

1N≒0.102kgf

Support Rail Unit TBR□S Series

Part Number Notation



Part number		Shaft Dia.	Basic Load Ratings		Weight		Dimensions(mm)			
Unit	Case**		Dynamic (N)	Static (N)	Case (kgf)	Rail (kgf/m)	D	h	H	E
TBR16S	TBR16UU	ϕ16	392	490	0.18	2.45	31	22.14	40	25
TBR20S	TBR20UU	ϕ20	784	1176	0.30	3.60	34	29.01	50	27.5
TBR25S	TBR25UU	ϕ25	1568	2352	0.60	5.60	41	31.97	60	32.5
TBR30S	TBR30UU	ϕ30	1764	2940	0.90	8.00	45.5	36.52	70	37.5

Part number	Dimensions(mm)												
	W	G	A	B	T	M	S_1	J	K	S_2	C	N*	P*
TBR16S	62	26	8	50	6	42	M5	50	30	ϕ5.5	37	20	150
TBR20S	68	31	10	55	8	51	M6	54	37	ϕ5.5	40	20	150
TBR25S	82	41	12	65	10	65	M8	65	50	ϕ6.6	45	25	200
TBR30S	91	48	12	75	12	75	M8	75	60	ϕ6.6	55	25	200

*: Standard

1N≒0.102kgf

SAMICK LINEAR BUSHING SYSTEM

SAMICK SHAFT SUPPORT

Shaft Support

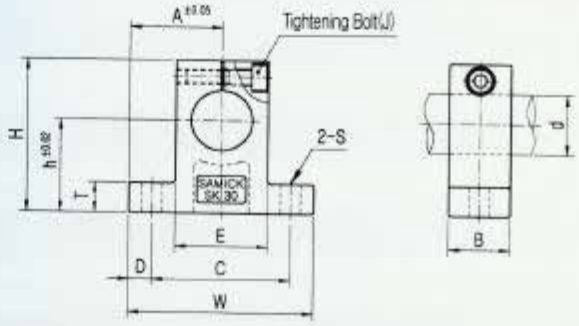
Support for Shaft ends. SAMICK Shaft Support is made of Aluminium with compact design, and able to fix the LM Shaft by slotting on axial direction and with fixing bolt.

SAMICK Shaft Support SK Series

SK □

SAMICK Shaft Support

LM Shaft Dia.



Part number	Shaft Dia.	Dimensions(mm)											Wgt. (g)
		h	A	W	H	T	E	D	C	B	S	J	
SK8	ø 8	20	21	42	32.8	6	18	5	32	14	ø 5.5	M4	24
SK10	ø 10	20	21	42	32.8	6	18	5	32	14	ø 5.5	M4	24
SK12	ø 12	23	21	42	38	6	20	5	32	14	ø 5.5	M4	30
SK13	ø 13	23	21	42	38	6	20	5	32	14	ø 5.5	M4	30
SK16	ø 16	27	24	48	44	8	25	5	38	16	ø 5.5	M4	40
SK20	ø 20	31	30	60	51	10	30	7.5	45	20	ø 6.6	M5	70
SK25	ø 25	35	35	70	60	12	38	7	56	24	ø 6.6	M6	130
SK30	ø 30	42	42	84	70	12	44	10	64	28	ø 9	M6	180
SK35	ø 35	50	49	98	85	15	50	12	74	32	ø 11	M8	270
SK40	ø 40	60	57	114	96	15	60	12	90	36	ø 11	M8	420

SAMICK LINEAR BUSHING SYSTEM

SAMICK LM SHAFT

LM Shaft SF Series

SAMICK supply precision LM shaft for SAMICK Linear Bushng. Because the balls are running directly on the shaft surface, the hardness, surface finishing, and tolerance of shaft should have care on production.
SAMICK can supply high quality LM shaft with short delivery by stocking the standard dimensional LM shafts.

■ Shaft Dimesnions

- Material : High carbon chromium bearing steel
- Hardness : HRC 58~64
- Case Hardened depth : 0.8~2.5 mm
- Surface finishing : 0.8S~1.6S
- Straightness : 50㎛/300mm

SAMICK LM shaft can be supplied either as solid or as holow shaft. Solid shaft are available in all dimensions required for SAMICK Linear Bushing and hollow shaft are available from diameter 12mm.

SAMICK also supply specially machined shaft as shown in the Fig 20. The drilled and tapped hole on LM shaft for mounting on the Support Rail is available.

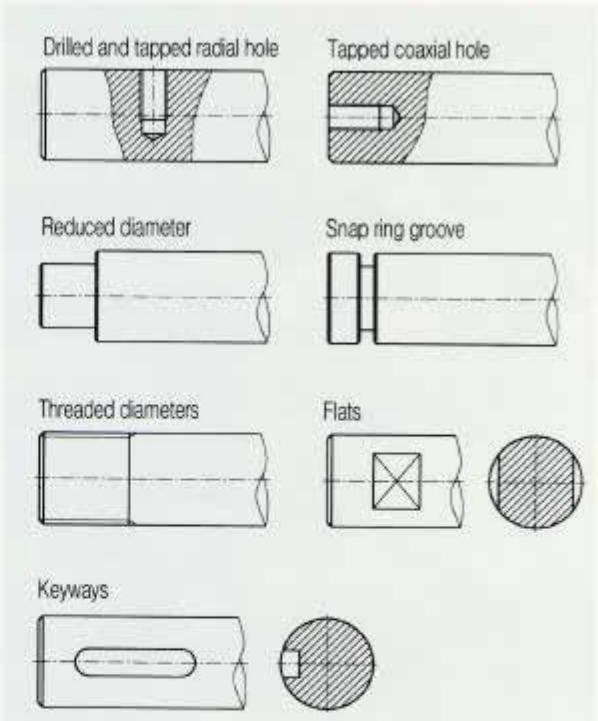


Fig 20

SF □-500L

SAMICK LM Shaft

LM Shaft Dia.

LM Shaft length

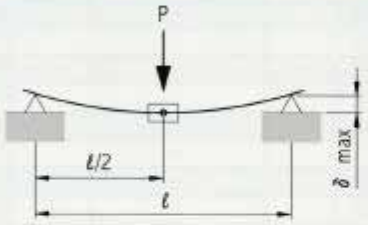
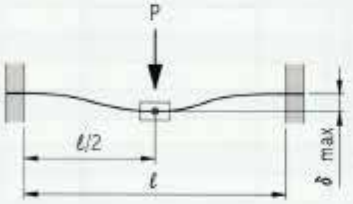
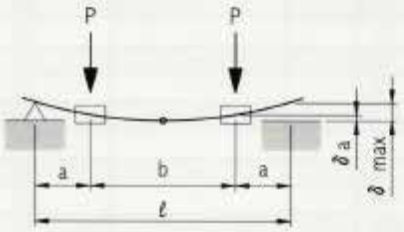
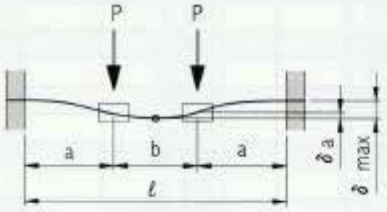
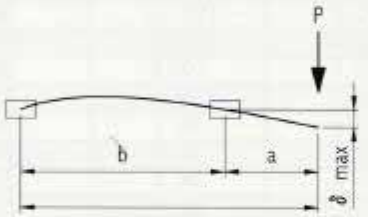
Part number	Shaft Dia.(g6)		Length of LM Shaft(mm)												
	d(mm)	Tol.(μm)	100	200	300	400	500	600	700	800	1000	1200	1300	1500	2000
SF 6	ø6	−0.004 −0.012	○	○	○	○	◎	–	–	–	–	–	–	–	–
SF 8	ø8	−0.005 −0.014	○	○	○	○	◎	–	–	–	–	–	–	–	–
SF 10	ø10		○	○	○	○	○	○	○	○	◎	◎	○	◎	–
SF 12	ø12	−0.006 −0.017	–	○	○	○	○	○	○	○	◎	◎	○	◎	–
SF 13	ø13		–	○	○	○	○	○	○	○	◎	◎	○	◎	–
SF 16	ø16		–	○	○	○	○	○	○	○	◎	◎	○	◎	–
SF 20	ø20	−0.007 −0.020	–	○	○	○	○	○	○	○	◎	◎	○	◎	◎
SF 25	ø25		–	○	○	○	○	○	○	○	◎	◎	○	◎	◎
SF 30	ø30		–	–	○	○	○	○	○	○	◎	◎	○	◎	◎
SF 35	ø35	−0.009 −0.025	–	–	–	–	○	○	○	○	◎	◎	○	◎	◎
SF 40	ø40		–	–	–	–	○	○	○	○	◎	◎	○	◎	◎
SF 50	ø50		–	–	–	–	○	○	○	○	◎	◎	○	◎	◎
SF 60	ø60	−0.010 −0.029	–	–	–	–	–	–	–	–	◎	◎	○	◎	◎
SF 80	ø80		–	–	–	–	–	–	–	–	◎	◎	○	◎	◎

◎ Standard
○ Quasi-Standard

SAMICK LINEAR BUSHING SYSTEM

Reference

Equation for shaft deflection amount calculation

Variations of support and Load	Equation for Deflection Amount (mm)
	$\delta_{max} = \frac{P \cdot \ell^3}{48 \cdot E \cdot I} = 2.021 \times 10^{-5} \frac{P \cdot \ell^3}{d^4}$
	$\delta_{max} = \frac{P \cdot \ell^3}{192 \cdot E \cdot I} = 5.053 \times 10^{-6} \frac{P \cdot \ell^3}{d^4}$
	$\delta_a = \frac{P \cdot a^2}{6 \cdot E \cdot I}(2a+3b) = 1.617 \times 10^{-4} \frac{P \cdot a^2(2a+3b)}{d^4}$ $\delta_{max} = \frac{P \cdot a^2}{24 \cdot E \cdot I}(3\ell^2-4a^2) = 4.042 \times 10^{-5} \frac{P \cdot a \cdot (3\ell^2-4a^2)}{d^4}$
	$\delta_a = \frac{P \cdot a^2}{6 \cdot E \cdot I}(2-\frac{3a}{\ell}) = 1.617 \times 10^{-4} \frac{P \cdot a^2}{d^4}(2-\frac{3a}{\ell})$ $\delta_{max} = \frac{P \cdot a^2}{24 \cdot E \cdot I}(2a+3b) = 4.042 \times 10^{-5} \frac{P \cdot a^2 \cdot (2a+3b)}{d^4}$
	$\delta_{max} = \frac{P \cdot a^2 \ell}{3 \cdot E \cdot I} = 3.234 \times 10^{-4} \frac{P \cdot a^2 \ell}{d^4}$

E : Modulus of longitudinal elasticity $2.1 \times 10^4 (kgf/mm^2)$;
P : Applying Load (kgf);
I : Geometrical Moment of inertia(mm^4) : $I = \pi d^4/64$ for solid shaft, and $I = \pi (d^4 - d_i^4)/64$ for hollow shaft
[d_i : shaft inside diameter(mm), d : diameter(mm)]

Hardness Conversion Table

Rockwell C Scale HRC	Vickers' Hardness Hv	Brienell Hardness Hʙ		Rockwell Hardness		Shore Hardaness Hs
		Standard Ball	Tungsten Carbon Ball	HʀA A Scale	HʀB B Scale	
68	940	–	–	85.6	–	97
67	900	–	–	85.0	–	95
66	865	–	–	84.5	–	92
65	832	–	739	83.9	–	91
64	800	–	722	83.4	–	88
63	772	–	705	82.8	–	87
62	746	–	688	82.3	–	85
61	720	–	670	81.8	–	83
60	697	–	654	81.2	–	81
59	674	–	634	80.7	–	80
58	653	–	615	80.1	–	78
57	633	–	595	79.6	–	76
56	613	–	577	79.0	–	75
55	595	–	560	78.5	–	74
54	577	–	543	78.0	–	72
53	560	–	525	77.4	–	71
52	544	500	512	76.8	–	69
51	528	487	496	76.3	–	68
50	513	475	481	75.9	–	67
49	498	464	469	75.2	–	66
48	484	451	455	74.7	–	64
47	471	442	443	74.1	–	63
46	458	432	432	73.6	–	62
45	446	421	421	73.1	–	60
44	434	409	409	72.5	–	58
43	423	400	400	72.0	–	57
42	412	390	390	71.5	–	56
41	402	381	381	70.9	–	55
40	392	371	371	70.4	–	54
39	382	362	362	69.9	–	52
38	372	353	353	69.4	–	51
37	363	344	344	68.9	–	50
36	354	336	336	68.4	(109.0)	49
35	345	327	327	67.9	(108.5)	48
34	336	319	319	67.4	(108.0)	47
33	327	311	311	66.8	(107.5)	46
32	318	301	301	66.3	(107.0)	44
31	310	294	294	65.8	(106.0)	43
30	302	286	286	65.3	(105.5)	42
29	294	279	279	64.7	(104.5)	41
28	286	271	271	64.3	(104.0)	41
27	279	264	264	63.8	(103.0)	40
26	272	258	258	63.3	(102.5)	38
25	266	253	253	62.8	(101.5)	38
24	260	247	247	62.4	(101.0)	37
23	254	243	243	62.0	100.0	36
22	248	237	237	61.5	99.0	35
21	243	231	231	61.0	98.5	35
20	238	226	226	60.5	97.8	34
(18)	230	219	219	–	96.7	33
(16)	222	212	212	–	95.5	32
(14)	213	203	203	–	93.9	31
(12)	204	194	194	–	92.3	29
(10)	196	187	187	–	90.7	28
(8)	188	179	179	–	89.5	27
(6)	180	171	171	–	87.1	26
(4)	173	165	165	–	85.5	25
(2)	166	158	158	–	83.5	24
0	160	152	152	–	81.7	24

Fitting Tolerances for Shaft and Housing Bore Diameter (Meteric Series)

Units: μm

Nominal Diameter (mm)		Tolerance of Shaft Diameter																Tolerance of Housing Bore Diameter														
		f			g			h				js			j			k			H				Js				J			K			M		
over	incl	f5	f6	f7	g5	g6	g7	h5	h6	h7	h8	js5	js6	js7	j5	j6	j7	k5	k6	k7	H5	H6	H7	H8	JS5	JS6	JS7	JS8	J6	J7	J8	K6	K7	K8	M6	M7	M8
–	3	−6	−10	−12	−16	−2	−6	−8	−12	0	−4	−6	−10	−14	±2	±3	±5	+2	−2	+4	−4	+6	−10	+14	0	±2	±3	±5	±7	+2	−4	+4	−6	+6	−8	0	−6	0	−10	0	−14	−2	−8	−2	−12	−2	−16
3	6	−10	−15	−18	−22	−4	−9	−12	−16	0	−5	−8	−12	−18	±2.5	±4	±5	+3	−2	+6	−4	+8	−12	+18	0	±2.5	±4	±6	±9	+5	−3	+6	−6	+10	−8	+2	−6	+3	−9	+5	−14	−1	−9	0	−12	+2	−16
6	10	−6	−19	−22	−28	−5	−11	−14	−20	0	−6	−9	−15	−22	±3	±4.5	±7	+4	−2	+7	−5	+10	−16	+22	0	±3	±4.5	±7	±11	+5	−4	+8	−7	+12	−10	+2	−7	+5	−10	+6	−16	−3	−12	0	−15	+1	−21
10	14	−16	−24	−27	−34	−6	−14	−17	−24	0	−8	−11	−18	−27	±4	±5.5	±9	+5	−3	+8	−6	+12	−19	+27	0	±4	±5.5	±9	±13	+6	−5	+10	−8	+15	−12	+2	−9	+6	−12	+8	−19	−4	−15	0	−18	+2	−25
14	18																																														
18	24	−20	−29	−33	−41	−7	−16	−20	−28	0	−9	−13	−21	−33	±4.5	±6.5	±10	+5	−4	+9	−7	+13	−23	+33	0	±4.5	±6.5	±10	±16	+8	−5	+12	−9	+20	−13	+2	−11	+6	−15	+10	−23	−4	−17	0	−21	+4	−29
24	30																																														
30	40	−25	−36	−41	−50	−9	−20	−25	−34	0	−11	−16	−25	−39	±5.5	±8	±12	+6	−5	+11	−8	+15	−27	+39	0	±5.5	±8	±12	±19	+10	−6	+14	−11	+24	−15	+3	−13	+7	−18	+12	−27	−4	−20	0	−25	+5	−34
40	50																																														
50	65	−30	−43	−49	−60	−10	−23	−29	−40	0	−13	−19	−30	−46	±6.5	±9.5	±15	+6	−7	+12	−9	+18	−32	+46	0	±6.5	±9.5	±15	±23	+13	−6	+18	−12	+28	−18	+4	−15	+9	−21	+14	−32	−5	−24	0	−30	+5	−41
65	80																																														
80	100	−36	−51	−58	−71	−12	−27	−34	−47	0	−15	−22	−35	−54	±7.5	±11	±17	+6	−9	+13	−11	+20	−38	+54	0	±7.5	±11	±17	±27	+16	−6	+22	−13	+34	−20	+4	−18	+10	−25	+16	−38	−6	−28	0	−35	+6	−48
100	120																																														
120	140	−43	−61	−68	−83	−14	−32	−39	−54	0	−18	−25	−40	−63	±9	±12.5	±20	+7	−11	+14	−13	+22	−43	+63	0	±9	±12.5	±20	±31	+18	−7	+26	−14	+41	−22	+4	−21	+12	−28	+20	−43	−8	−33	0	−40	+8	−55
140	160																																														
160	180																																														

Fitting Tolerances for Shaft and Housing Bore Diameter (Inch Series)

Tolerance of housing bore

	SIZE		H5		H6		H7		H8	
	inch	mm	inch	mm	inch	mm	inch	mm	inch	mm
Over	0.1181	3	0.0002	0.005	0.0003	0.008	0.0004	0.012	0.0007	0.018
To	0.2362	6	0	0	0	0	0	0	0	0
Over	0.2362	6	0.0002	0.006	0.0003	0.009	0.0003	0.015	0.0008	0.022
To	0.3937	10	0	0	0	0	0	0	0	0
Over	0.3937	10	0.0003	0.008	0.0004	0.011	0.0007	0.018	0.0010	0.027
To	0.7087	18	0	0	0	0	0	0	0	0
Over	0.7087	18	0.0003	0.009	0.0005	0.013	0.0008	0.021	0.0013	0.033
To	1.1811	30	0	0	0	0	0	0	0	0
Over	1.1811	30	0.0004	0.011	0.0006	0.016	0.0009	0.025	0.0015	0.039
To	1.9685	50	0	0	0	0	0	0	0	0
Over	1.9685	50	0.0005	0.013	0.0007	0.019	0.0011	0.030	0.0018	0.046
To	3.1496	80	0	0	0	0	0	0	0	0
Over	3.1496	80	0.0005	0.015	0.0008	0.022	0.0013	0.035	0.0021	0.054
To	4.7244	120	0	0	0	0	0	0	0	0

Tolerance of shaft

	SIZE		g5		g6		g7		h5		h6		h7	
	inch	mm	inch	mm	inch	mm	inch	mm	inch	mm	inch	mm	inch	mm
Over	0.1181	3	-0.0001	-0.004	-0.0001	-0.004	-0.0001	-0.004	0	0	0	0	0	0
To	0.2362	6	-0.0003	-0.009	-0.0004	-0.012	-0.0006	-0.016	-0.0002	-0.005	-0.0003	-0.008	0.0004	-0.012
Over	0.2362	6	-0.0002	-0.005	-0.0002	-0.005	-0.0002	-0.005	0	0	0	0	0	0
To	0.3937	10	-0.0004	-0.011	-0.0005	-0.014	-0.0007	-0.020	-0.0002	-0.006	-0.0003	-0.009	-0.0006	-0.015
Over	0.3937	10	-0.0002	-0.006	-0.0002	-0.006	-0.0002	-0.006	0	0	0	0	0	0
To	0.7087	18	-0.0005	-0.014	-0.0006	-0.017	-0.0009	-0.024	-0.0003	-0.008	-0.0004	-0.011	-0.0007	-0.018
Over	0.7087	18	-0.0002	-0.007	-0.0002	-0.007	-0.0002	-0.007	0	0	0	0	0	0
To	1.1811	30	-0.0006	-0.016	-0.0007	-0.020	-0.0011	-0.028	-0.0003	-0.009	-0.0005	-0.013	-0.0008	-0.021
Over	1.1811	30	-0.0003	-0.009	-0.0003	-0.009	-0.0003	-0.009	0	0	0	0	0	0
To	1.9685	50	-0.0007	-0.020	-0.0009	-0.025	-0.0013	-0.034	-0.0004	-0.011	-0.0006	-0.016	-0.0009	-0.025
Over	1.9685	50	-0.0004	-0.010	-0.0004	-0.010	-0.0004	-0.010	0	0	0	0	0	0
To	3.1496	80	-0.0009	-0.023	-0.0011	-0.029	-0.0015	-0.04	-0.0005	-0.013	-0.0007	-0.019	-0.011	-0.030
Over	3.1496	80	-0.0004	-0.012	-0.004	-0.012	-0.0004	-0.012	0	0	0	0	0	0
To	4.7244	120	-0.00010	-0.027	-0.0013	-0.034	-0.0018	-0.047	-0.0006	-0.015	-0.0008	-0.022	-0.0013	-0.035