STROKE BUSH

The NB stroke bush is a linear and rotational motion mechanism utilizing the rotational motion of ball elements between an outer cylinder and a shaft. It is compact and can withstand high loading.
The retainer is made of a light metal alloy with high wear resistance. Smooth motion is achieved under high-speed and high-acceleration conditions.
Although the linear motion is limited to a specific stroke length, the combined rotation and stroke motion is achieved with very little frictional resistance.
The NB stroke bush can be conveniently used in a variety of applications.

STRUCTURE AND ADVANTAGES

The retainer in the NB stroke bush positions the ball elements in a zigzag arrangement. The inner surface of the outer cylinder is finished by precision grinding, resulting in smooth motion of the ball elements. Each of the ball elements is held in a separate hole and smooth motion is achieved for both rotational motion and linear motion. The retainer moves half the length of the linear motion, therefore, the stroke length is limited to approximately twice the length the retainer can travel within the outer cylinder.

● High Precision

High-carbon chromium bearing steel is used for the outer cylinder. It is heat treated and ground to achieve high rigidity and accuracy.

● Ease of Mounting and Replacement

The highly accurate fabrication of the NB stroke bush results in uniform dimensions, facilitating parts replacement and housing fabrication.

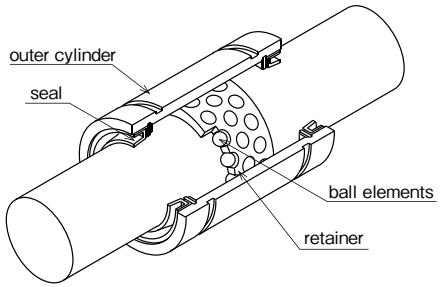
● Light Weight and Space Saving

The use of an aluminum alloy for the retainer and the thin-wall outer cylinder makes the NB stroke bush light weight and compact.

● Lubrication

One lubrication hole is provided on each oil groove of the outer cylinder, making it easy to lubricate the SR stroke bush.

Figure E-1 Structure of SR Stroke Bush



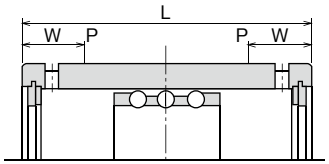
ACCURACY

The accuracies of the SR stroke bush are stated in the dimension tables. Since the outer cylinder deforms due to tension from the retaining ring, the dimension of the outer cylinder is an average value at points P, where calculated using the following equation:

$$W=4+\frac{L}{8}$$

W: the distance from the end of the outer cylinder to measurement point P
L: the length of the outer cylinder

Figure E-2 Outer Cylinder Measurement Points



FIT

The fits generally used between the shaft and the housing are listed in Table E-1. The inner contact diameters of the SR stroke bush are listed in the dimension tables. The shaft diameter tolerance should be selected to achieve the desired amount of radial clearance (see Table E-2). Please pay attention that high-speed linear motion can cause the retainer to slip due to inertial force.
In selecting a shaft, please take note of:
Hardness: 58HRC or more (refer to hardness coefficient on page Eng-5) recommended
Surface Roughness: less than Ra0.4 recommended

Table E-1

normal operating condition		vertical use or highly accurate case	
shaft	housing	shaft	housing
k5,m5	H6,H7	n5,p6	J6,J7

Table E-2 Radial Clearance Negative Limit

part number	limit (μm)
6	− 2
8～10	− 3
12～16	− 4
20～30	− 5
35～50	− 6
60～80	− 8
100	−10

RATED LOAD AND RATED LIFE

The relationship between the rated load and life of the stroke bush is expressed as follows:

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

L: rated life (10^6 rotations)　f_H: hardness coefficient
f_T: temperature coefficient　f_C: contact coefficient
f_W: applied load coefficient
C: basic dynamic load rating (N)
P: applied load (N)
※Refer to page Eng-5 for the coefficients.

●For combined rotation and stroke motion

$$L_h=\frac{10^6 \cdot L}{60\sqrt{(dm \cdot n)^2+(10 \cdot S \cdot n_1)^2}/dm}$$

●For stroke motion

$$L_h=\frac{10^6 \cdot L}{600 \cdot S \cdot n_1/(\pi \cdot dm)}$$

L_h: life time (hr)　S: stroke length (mm)
n: revolutions per min. (rpm)
n_1: number of cycles per minute (cpm)
dm: ball pitch diameter (mm) ≒ 1.15 dr

ALLOWABLE SPEED FOR COMBINED ROTATION AND STROKE MOTION

The allowable speed for combined rotation and stroke motion is obtained from the following equation:

$$DN \geqq dm \cdot n+10 \cdot S \cdot n_1$$

The value of DN is given as follows depending on the lubrication method.

for oil lubrication	DN=600,000
for grease lubrication	DN=300,000

note……$n \leqq 5{,}000$　$S \cdot n_1 \leqq 50{,}000$

USE AND HANDLING PRECAUTIONS

Maximum Stroke

The maximum stroke in the dimension table is the stroke limit.

Retainer Slippage

The retainer can slip under high-speed motion, vertical application, unbalanced-loading, and vibrating conditions.
It is suggested that the stroke to be set as a 80% of the maximum stroke in the dimension table. It is also recommended that the bush be cycled to perform the maximum stroke several times, so that the retainer returns to its central position.

SLIDE ROTARY BUSH SRE SERIES

The NB Slide Rotary Bush SRE Series provides rotary and linear motion functions. Linear motion with unlimited stroke and rotary motion are merged into a single bush resulting in great space saving compared with a combination of any conventional bearings. There are three types; standard, flange, and unit type with sizes ranging from 6 to 40.

STRUCTURE AND ADVANTAGES

NB Slide Rotary Bush features a special retainer fitted into cylindrical steel outer cylinder and is designed to guide steel balls for smooth circulation in its retainer. The retainer is also designed to rotate freely towards radial direction and offers smooth linear and rotary motions.

●Smooth Operation

The inner surface of the outer cylinder allows smooth operation of linear and rotary motions while maintaining a uniform load distribution.

●High Load Capacity

The use of comparatively large diameter steel balls enhances the load capacity.

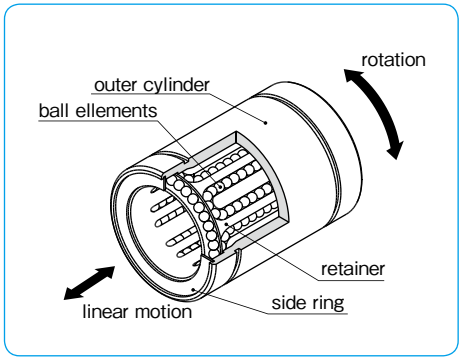
●Smooth Rotation

The positioning of the steel balls in a cylindrical formation inside the retainer enables a smooth rotational motion regardless of the installation direction.

●Complete Interchangeability

NB Slide Rotary series is completely interchangeable with SM type Slide Bush, SMK type Flanged Slide Bush and SMA(W) type, AK(W) type and SMP type.

Figure E-3 Structure of Slide Rotary Bush SRE type



RATED LIFE AND LOAD RATING

The rated life and load rating are defined as follows.

●Rated Life

When a group of slide rotary bearings of the same type are used under the same conditions, the rated life is defined as the total number of rotations made without causing flaking by 90% of the bearings.

●Basic Dynamic Load Rating

The basic dynamic load rating is defined as the load with a constant magnitude and direction at which a rated life of 10^6 rotations can be achieved.

●Basic Static Load Rating

The basic static load rating is defined as the load with a constant direction that would result in a certain contact stress at the mid-point of the rolling element and tracking surface that are experiencing the maximum stress.

Equation (1) gives the relation between the applied load and the rated life of the slide rotary bush.

$$L=\left(\frac{f_H \cdot f_T \cdot f_C}{f_W} \cdot \frac{C}{P}\right)^3 \quad \cdots\cdots (1)$$

L: rated life (10^6 rotations) f_H: hardness coefficient
f_T: temperature coefficient f_C: contact coefficient
f_W: applied load coefficient C: basic dynamic load rating (N)
P: applied load (N)
※Refer to page Eng-5 for the coefficients.

Since the slide rotary bush is used in applications with combined linear and rotary motions, the life time is obtained using Equations (2) and (3) .

●When linear and rotary motions are combined

$$L_h=\frac{10^6 \cdot L}{60\sqrt{(dm \cdot n)^2+(10 \cdot S \cdot n_1)^2}/dm} \cdots (2)$$

●When only linear motion is involved

$$L_h=\frac{10^6 \cdot L}{600 \cdot S \cdot n_1/(\pi \cdot dm)} \quad \cdots\cdots (3)$$

L_h: life time (hr) S: stroke length (mm) n: revolutions per minute (rpm) n_1: number of cycles per minute (cpm)
dm: ball pitch diameter (mm)≒1.15dr (dr is the inner contact diameter of the SRE series)

Calculation Example

The life of SRE20 type NB slide rotary bush is calculated based on the following conditions.

●Conditions

Motion: Linear and rotational combined Load: P=30N Stroke: S=200mm
Revolutions per minute: n=15rpm Number of cycles per minute: n_1=10cpm
Shaft surface hardness: greater than 58 HRC
Operating temperature: room temperature Other: single shaft with single bush

●Calculation

Basic dynamic load rating: C=647 N
Based on the above conditions, the life is calculated using the following coefficient values.
Hardness coefficient f_H=1, Temperature coefficient f_T=1, Contact coefficient f_C=1
Applied load coefficient, f_W=1.5

Rated life

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

$$=\left(\frac{1\times1\times1}{1.5} \cdot \frac{647}{30}\right)^3 = 2{,}972\ (10^6 \text{ rotations})$$

Life (in hours)

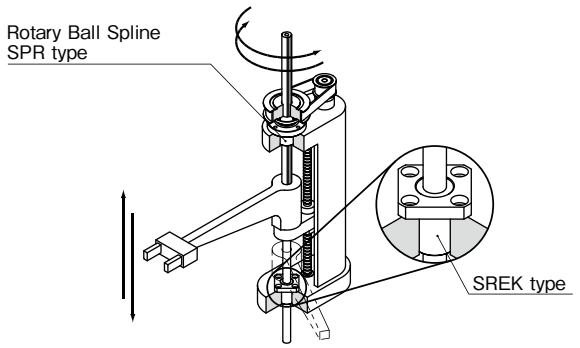
$$L_h=\frac{10^6 \cdot L}{60\sqrt{(dm \cdot n)^2+(10 \cdot S \cdot n_1)^2}/dm}$$

$$=\frac{10^6\times2{,}972}{60\sqrt{(1.15\times20\times15)^2+(10\times200\times10)^2}/(1.15\times20)}$$

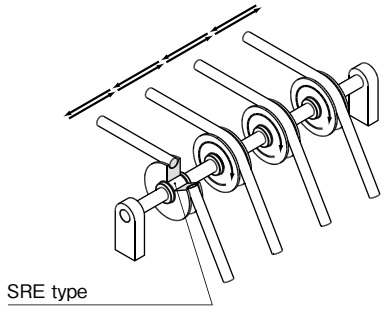
$$=56{,}900\ (h)$$

APPLICATION EXAMPLES

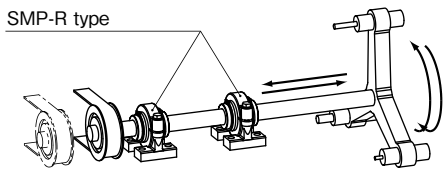
Application Example 1　Vertical Shaft Robot Arm



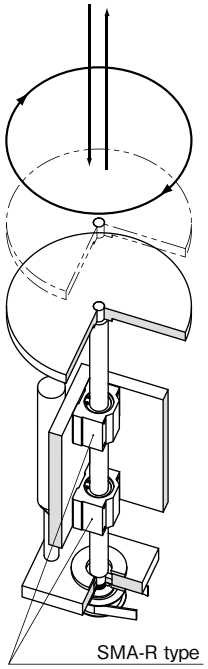
Application Example 2　Multiple Gearing Idler



Application Example 3　Tool Changer



Application Example 4　Turntable



USE AND HANDLING PRECAUTIONS

●Shaft

Since the ball elements rotate on the shaft surface in the SRE type slide rotary bush, the accuracy and hardness of the shaft are important factors.

Outer Diameter: A tolerance of g6 is recommended for smooth operation.

Hardness: A hardness of greater than 58HRC is recommended for long life. If the hardness is less than 58 HRC, the life is calibrated using the hardness coefficient.

Surface Roughness: A roughness of less than Ra0.4 is recommended.

●Housing

An inner diameter tolerance of H7 is recommended for housing.

●Lubrication

Lubrication is needed (1) to prevent heat fusing by reducing friction between the rolling elements and the tracking surface, (2) to reduce wear of the structural elements, and (3) to prevent rusting. Lubrication affects both the performance and life of the bush. A lubrication method and a lubrication agent appropriate to the operating conditions should be selected. For oil lubrication, turbine oil (ISO standard VG32-68) is recommended. For grease lubrication, lithium soap based grease No. 2 is recommended. The replenishment interval depends on the operating conditions.

●Dust Prevention

Dust and other contaminants affect the bush's lifetime and accuracy. Appropriate prevention methods are thus important.

●Operating Temperature Range

The operating temperature is ranging from −20℃ to 110℃. In case of operation at a temperature outside this range, please contact NB.

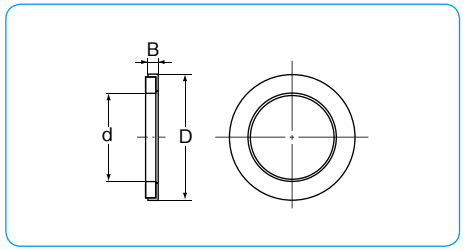
●Retainer Material

The standard material of SRE Retainer is copper alloy (stainless steel for size 12). When requiring other material, please contact NB.

FELT SEAL

A felt seal FLM strengthens lubrication characteristics and extends relubrication period of the slide rotary bush.

Figure E-4 Felt Seal



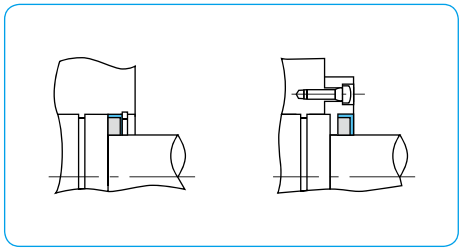
Installation

The felt seal does not work as a retaining ring. Figure E-5 shows how to install the felt seal.

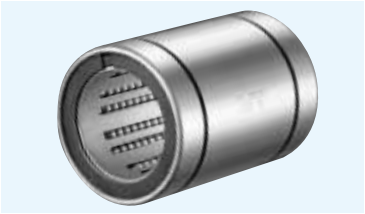
Table E-3 Felt Seal Dimensions

part number	major dimensions (mm) d	D	B	applicable slide rotary bush
FLM 6	6	12	2	SRE 6
FLM 8	8	15	2	SRE 8
FLM 10	10	19	3	SRE 10
FLM 12	12	21	3	SRE 12
FLM 13	13	23	3	SRE 13
FLM 16	16	28	4	SRE 16
FLM 20	20	32	4	SRE 20
FLM 25	25	40	5	SRE 25
FLM 30	30	45	5	SRE 30
FLM 40	40	60	5	SRE 40

Figure E-5 Example of Installation



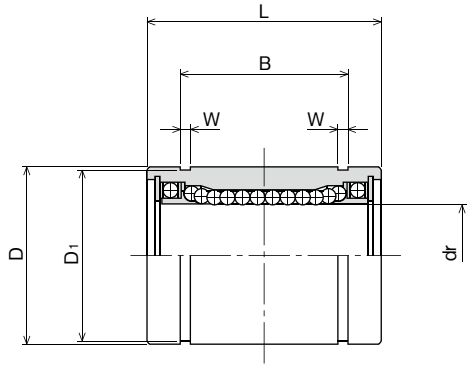
SRE TYPE

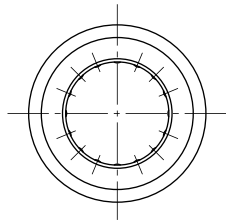


part number structure

example SRE 25

SRE type — inner contact diameter (dr)





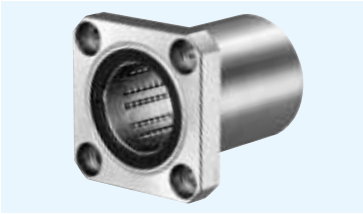
part number	major dimensions dr mm	dr tolerance μm	D mm	D tolerance μm	L mm	L tolerance mm	B mm	B tolerance mm
SRE 6	6	+4 −5	12	0 −11	19	0 −0.2	13.5	0 −0.2
SRE 8	8		15		24		17.5	
SRE10	10		19	0 −13	29		22	
SRE12	12	+3 −6	21		30		23	
SRE13	13		23		32		23	
SRE16	16		28		37		26.5	
SRE20	20	+3 −7	32	0 −16	42		30.5	
SRE25	25		40		59	0 −0.3	41	0 −0.3
SRE30	30		45		64		44.5	
SRE40	40	+3/−8	60	0/−19	80		60.5	

※If the inner contact diameter exceeds 40 mm, please contact NB.

W mm	D1 mm	basic load rating dynamic C N	basic load rating static Co N	allowable revolutions per minute rpm	mass g	part number
1.1	11.5	78	176	300	10	SRE 6
1.1	14.3	137	314	300	20	SRE 8
1.3	18	157	372	300	39	SRE10
1.3	20	274	588	300	42	SRE12
1.3	22	323	686	300	56	SRE13
1.6	27	451	882	250	97	SRE16
1.6	30.5	647	1,180	250	133	SRE20
1.85	38	882	1,860	250	293	SRE25
1.85	43	1,180	2,650	200	371	SRE30
2.1	57	1,960	4,020	200	778	SRE40

1N≒0.102kgf

SREK TYPE
— Square Flange type —

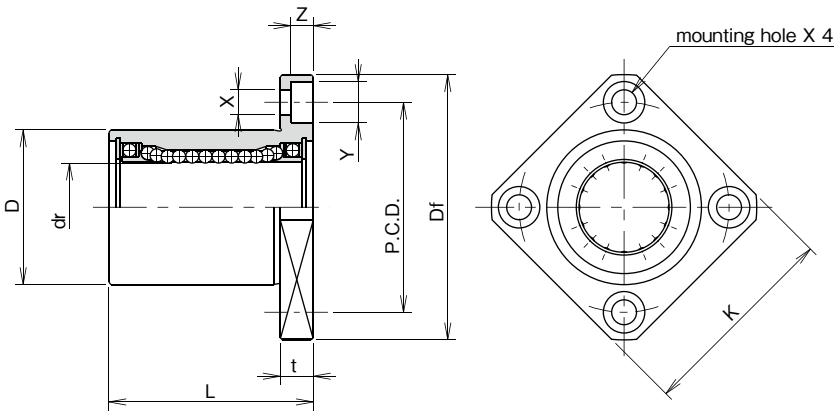


part number structure

example SREK 25

SREK type

inner contact diameter (dr)



part number	major dimensions								
	dr		D		L			flange	
	mm	tolerance μm	mm	tolerance μm	±0.3 mm	Df mm	K mm	t mm	
SREK 6	6	+4 −5	12	0 −13	19	28	22	5	SREK 6
SREK 8	8		15		24	32	25	5	SREK 8
SREK10	10		19	0 −16	29	40	30	6	SREK10
SREK12	12	+3 −6	21		30	42	32	6	SREK12
SREK13	13		23		32	43	34	6	SREK13
SREK16	16		28		37	48	37	6	SREK16
SREK20	20	+3 −7	32	0 −19	42	54	42	8	SREK20
SREK25	25		40		59	62	50	8	SREK25
SREK30	30		45		64	74	58	10	SREK30

P.C.D. mm	X×Y×Z mm	perpendicularity μm	basic load rating dynamic C N	basic load rating static Co N	allowable revolutions per minute rpm	mass g	part number
20	3.5×6×3.1	12	78	176	300	21	SREK 6
24	3.5×6×3.1		137	314	300	33	SREK 8
29	4.5×7.5×4.1		157	372	300	61	SREK10
32	4.5×7.5×4.1		274	588	300	67	SREK12
33	4.5×7.5×4.1		323	686	300	83	SREK13
38	4.5×7.5×4.1		451	882	250	126	SREK16
43	5.5×9×5.1	15	647	1,180	250	178	SREK20
51	5.5×9×5.1		882	1,860	250	355	SREK25
60	6.6×11×6.1		1,180	2,650	200	483	SREK30

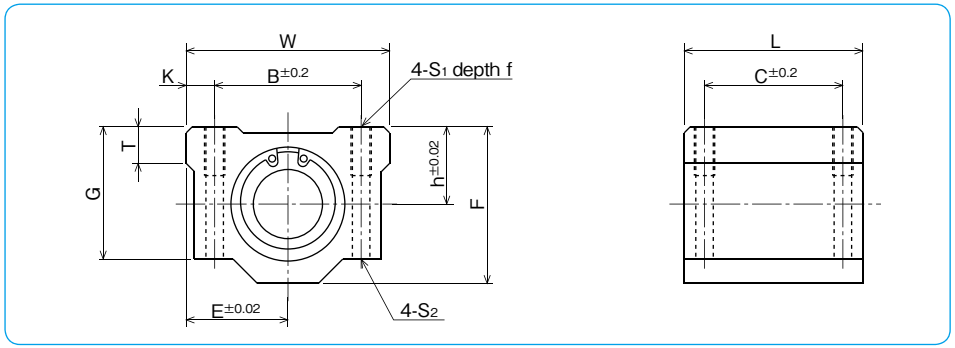
1N≒0.102kgf

SMA-R TYPE
—Block type—

part number structure

example **SMA 25 R**

- SMA → SMA-R type
- 25 → inner contact diameter
- R



part number	inner contact diameter	tolerance	major dimensions: outer dimensions h	E	W	L	F	G	T	mounting dimensions B	C	K	S1	f	S2	basic load rating dynamic C	static Co	allowable revolutions per minute	mass
	mm	μm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm		mm	mm	N	N	rpm	g
SMA 6R	6	+4 −5	9	15	30	25	18	15	6	20	15	5	M4	8	3.4	78	176	300	33
SMA 8R	8		11	17	34	30	22	18	6	24	18	5	M4	8	3.4	137	314	300	55
SMA10R	10		13	20	40	35	26	21	8	28	21	6	M5	12	4.3	157	372	300	93
SMA12R	12	+3 −6	15	21	42	36	28	24	8	30.5	26	5.75	M5	12	4.3	274	588	300	104
SMA13R	13		15	22	44	39	30	24.5	8	33	26	5.5	M5	12	4.3	323	686	300	128
SMA16R	16		19	25	50	44	38.5	32.5	9	36	34	7	M5	12	4.3	451	882	250	216
SMA20R	20	+3 −7	21	27	54	50	41	35	11	40	40	7	M6	12	5.2	647	1,180	250	286
SMA25R	25		26	38	76	67	51.5	42	12	54	50	11	M8	18	7	882	1,860	250	645
SMA30R	30		30	39	78	72	59.5	49	15	58	58	10	M8	18	7	1,180	2,650	200	824
SMA40R	40	+3/−8	40	51	102	90	78	62	20	80	60	11	M10	25	8.7	1,960	4,020	200	1,719

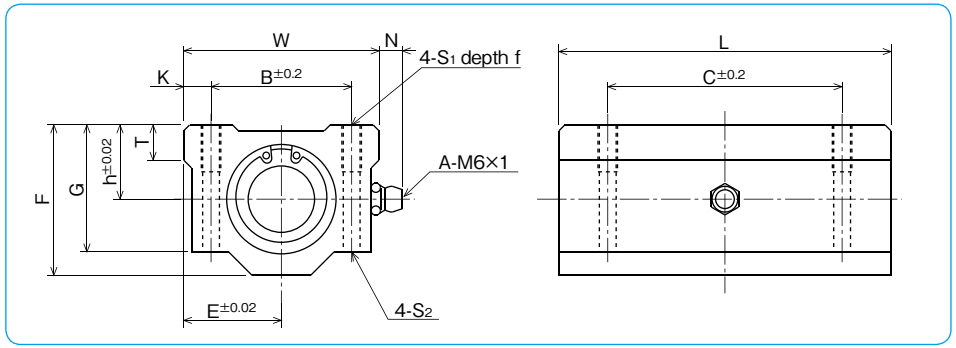
1N≒0.102kgf

SMA-RW TYPE
—Double-Wide Block type—

part number structure

example **SMA 25 R W**

- SMA → SMA-R type
- 25 → inner contact diameter
- R
- W → double type



part number	inner contact diameter	tolerance	major dimensions: outer dimensions h	E	W	L	F	G	T	N	mounting dimensions B	C	K	S1	f	S2	basic load rating dynamic C	static Co	allowable revolutions per minute	mass
	mm	μm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm		mm	mm	N	N	rpm	g
SMA 6RW	6	+4 −5	9	15	30	48	18	15	6	7	20	36	5	M4	8	3.4	126	352	300	68
SMA 8RW	8		11	17	34	58	22	18	6	7	24	42	5	M4	8	3.4	222	628	300	113
SMA10RW	10		13	20	40	68	26	21	8	7	28	46	6	M5	12	4.3	254	744	300	188
SMA12RW	12	+3 −6	15	21	42	70	28	24	8	6.5	30.5	50	5.75	M5	12	4.3	444	1,180	300	210
SMA13RW	13		15	22	44	75	30	24.5	8	6.5	33	50	5.5	M5	12	4.3	523	1,370	300	254
SMA16RW	16		19	25	50	85	38.5	32.5	9	6	36	60	7	M5	12	4.3	731	1,760	250	431
SMA20RW	20	+3 −7	21	27	54	96	41	35	11	7	40	70	7	M6	12	5.2	1,050	2,360	250	568
SMA25RW	25		26	38	76	130	51.5	42	12	4	54	100	11	M8	18	7	1,430	3,720	250	1,282
SMA30RW	30		30	39	78	140	59.5	49	15	5	58	110	10	M8	18	7	1,910	5,300	200	1,638
SMA40RW	40	+3/−8	40	51	102	175	78	62	20	5	80	140	11	M10	25	8.7	3,180	8,040	200	3,419

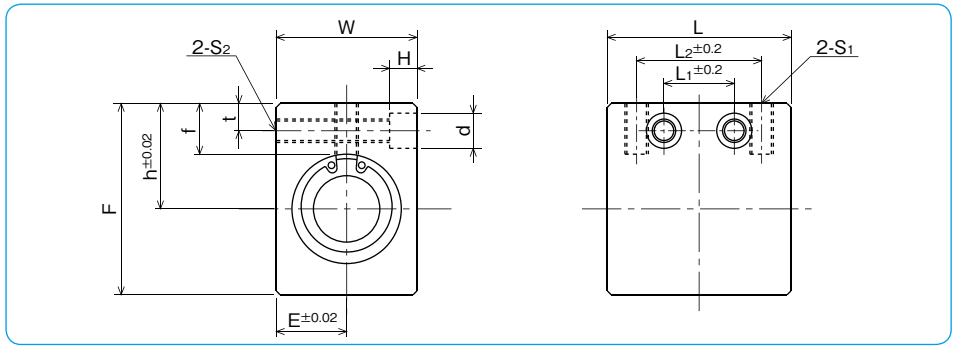
1N≒0.102kgf

AK-R TYPE
—Compact Block type—

part number structure

example **AK 25 R**

- AK-R type
- 25 — inner contact diameter



part number	inner contact diameter	tolerance	major dimensions: outer dimensions h	E	W	L	F	mounting dimensions: L2	S1	f	L1	t	S2	d	H	basic load rating: dynamic C	static Co	allowable revolutions per minute	mass
	mm	μm	mm	mm	mm	mm	mm	mm		mm	mm	mm		mm	mm	N	N	rpm	g
AK 6R	6	+4 −5	14	8	16	27	22	18	M4	8	9	5	M4	6	5	78	176	300	27
AK 8R	8		16	10	20	32	26	20	M5	8.5	10	5	M4	6	5	137	314	300	48
AK10R	10		19	13	26	39	32	27	M6	9.5	15	6	M5	8	6	157	372	300	94
AK12R	12	+3 −6	20	14	28	40	34	27	M6	9.5	15	6	M5	8	6	274	588	300	105
AK13R	13		25	15	30	42	43	28	M6	13.5	16	7	M6	9	7	323	686	300	151
AK16R	16		27	18	36	47	49	32	M6	13	18	7	M6	9	7	451	882	250	238
AK20R	20	+3 −7	31	21	42	52	54	36	M8	15	18	8	M8	11	8	647	1,180	250	328
AK25R	25		37	26	52	69	65	42	M10	17	22	9	M10	14	10	882	1,860	250	669
AK30R	30		40	29	58	74	71	44	M10	17.5	22	9	M10	14	10	1,180	2,650	200	856

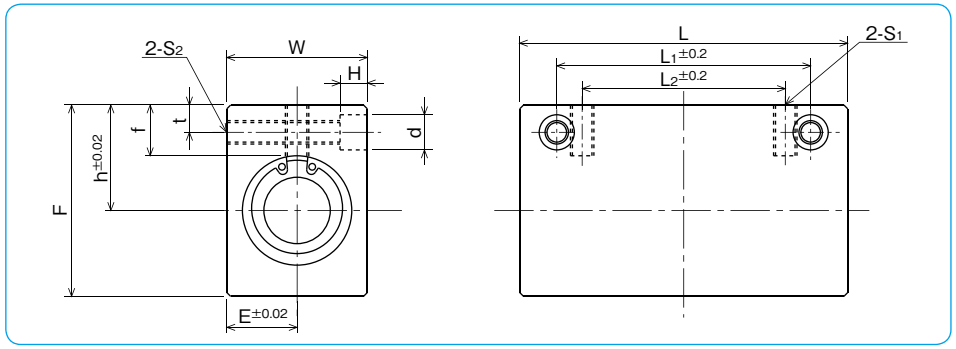
1N≒0.102kgf

AK-RW TYPE
—Double-Wide Compact Block type—

part number structure

example **AK 25 R W**

- AK-R type
- 25 — inner contact diameter
- W — double type



part number	inner contact diameter	tolerance	major dimensions: outer dimensions h	E	W	L	F	mounting dimensions: L2	S1	f	L1	t	S2	d	H	basic load rating: dynamic C	static Co	allowable revolutions per minute	mass
	mm	μm	mm	mm	mm	mm	mm	mm		mm	mm	mm		mm	mm	N	N	rpm	g
AK 6RW	6	+4 −5	14	8	16	46	22	20	M4	8	30	5	M4	6	5	126	352	300	48
AK 8RW	8		16	10	20	56	26	30	M5	8.5	42	5	M4	6	5	222	628	300	89
AK10RW	10		19	13	26	68	32	36	M6	9.5	50	6	M5	8	6	254	744	300	175
AK12RW	12	+3 −6	20	14	28	70	34	36	M6	9.5	50	6	M5	8	6	444	1,180	300	196
AK13RW	13		25	15	30	74	43	42	M6	13.5	55	7	M6	9	7	523	1,370	300	281
AK16RW	16		27	18	36	84	49	52	M6	13	65	7	M6	9	7	731	1,760	250	450
AK20RW	20	+3 −7	31	21	42	94	54	58	M8	15	70	8	M8	11	8	1,050	2,360	250	626
AK25RW	25		37	26	52	128	65	80	M10	17	100	9	M10	14	10	1,430	3,720	250	1,299
AK30RW	30		40	29	58	138	71	90	M10	17.5	110	9	M10	14	10	1,910	5,300	200	1,662

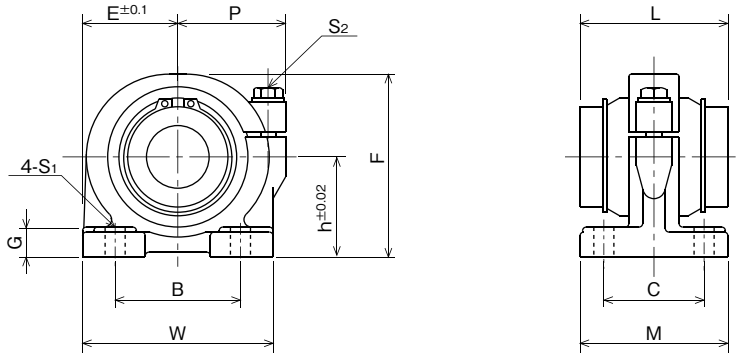
1N≒0.102kgf

SMP-R TYPE
—Pillow Block type—

part number structure

example SMP 25 R

- SMP-R type
- inner contact diameter



part number	inner contact diameter		major dimensions: outer dimensions h	E	W	L	F	G	M
	mm	tolerance μm	mm	mm	mm	mm	mm	mm	mm
SMP13R	13	+3 −6	25	25	50	32	46	8	36
SMP16R	16		29	27.5	55	37	53	10	40
SMP20R	20	+3 −7	34	32.5	65	42	62	12	48
SMP25R	25		40	38	76	59	73	12	59
SMP30R	30		45	42.5	85	64	84	15	69
SMP40R	40	+3/−8	60	62	124	80	112	18	86

P	mounting dimensions: B	C	S1	adjustment screw size	basic load rating: dynamic C	static Co	allowable revolutions per minute	mass	part number
mm	mm	mm	mm	S2	N	N	rpm	g	
30	30	26	7 (M5)	M5	323	686	300	266	SMP13R
32	35	29	7 (M5)	M5	451	882	250	369	SMP16R
37	40	35	8 (M6)	M6	647	1,180	250	690	SMP20R
43	50	40	8 (M6)	M6	882	1,860	250	970	SMP25R
49	58	46	10 (M8)	M8	1,180	2,650	200	1,420	SMP30R
68	76	64	12 (M10)	M10	1,960	4,020	200	3,585	SMP40R

1N≒0.102kgf