

## Miniature Stroke Rotary Bushing

# STSI



## Points

### 1 Rotational and linear motions

With the combination of an external cylinder with cylindrical raceway and balls incorporated in the retainer, rotary and linear motion in the axial direction is possible simultaneously with rotational motion.

### 2 Super small size

With the ultra-small sized balls incorporated in a thin external cylinder, small diameter and small sectional height are realized.

### 3 Super precision

Balls of high accuracy are incorporated with super-finished external cylinder and shaft to be adjusted to zero or minimal amount of preload, which realizes rotational motion and rotary and linear motion of high accuracy.

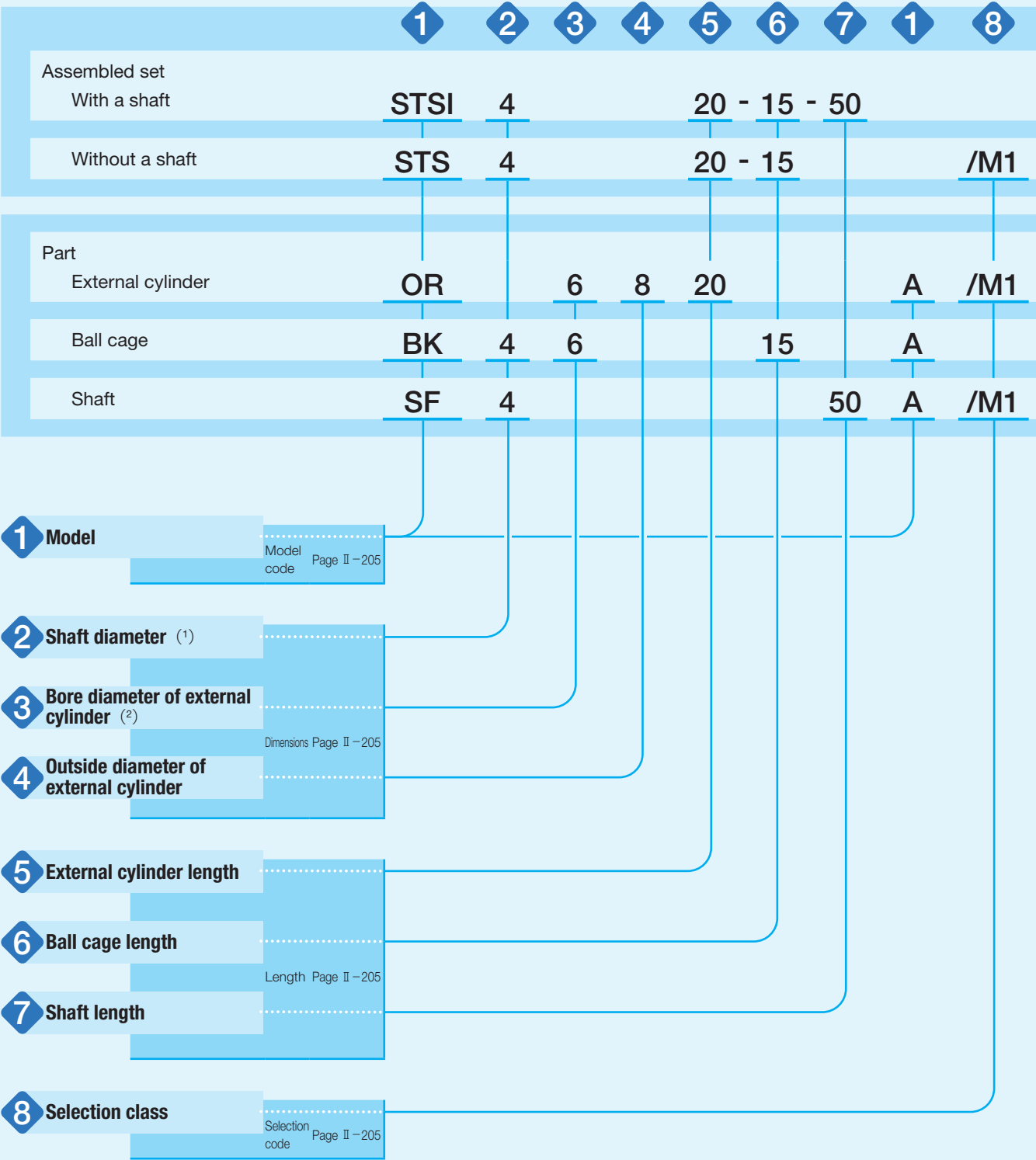
### 4 Extremely smooth operation

Since each component is precisely grounded and adjusted to ideal preload condition, extremely smooth and stable operation with small frictional resistance for long term can be achieved.

# Identification Number and Specification

## Example of an identification number

The specification of STSI series is indicated by the identification number. Indicate the identification number, consisting of a model code, dimensions, length, and a selection code for each specification to apply.

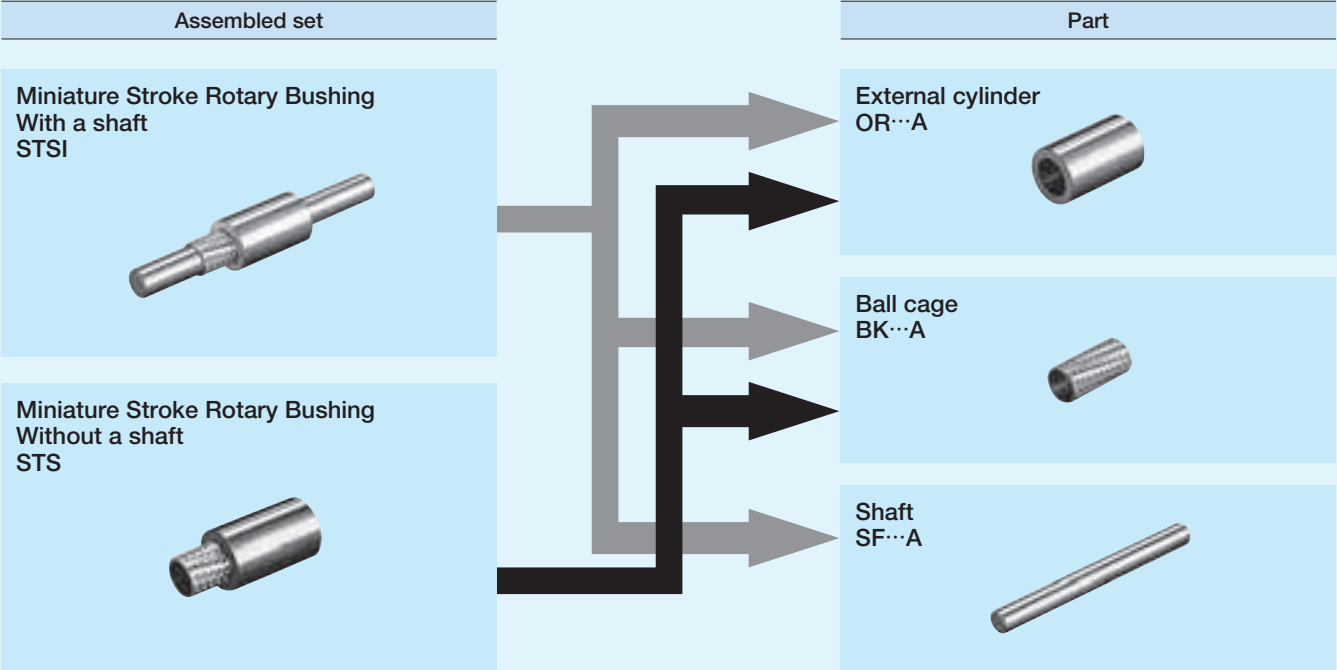


Notes (1) Indicates inscribed circle diameter for assembled set without a shaft or ball cage.  
(2) Indicates circumscribed circle diameter for ball cage.

# Identification Number and Specification

1	Model	Miniature Stroke Rotary Bushing (STSI series)	Assembled set with a shaft : STSI Assembled set without a shaft : STS External cylinder : OR...A Ball cage : BK...A Shaft : SF...A
2	Shaft diameter		Indicate the shaft diameter in mm. Indicates inscribed circle diameter for assembled set without a shaft or ball cage.
3	Bore diameter of external cylinder		Indicate the bore diameter of external cylinder in mm. Indicates circumscribed circle diameter for ball cage.
4	Outside diameter of external cylinder		Indicate the outside diameter of external cylinder in mm.
5	External cylinder length		Indicate the external cylinder length in mm.
6	Ball cage length		Indicate the ball cage length in mm.
7	Shaft length		Indicate the shaft length in mm.
8	Selection class	M1 class : M1 M2 class : M2 M3 class : M3	Selection code and tolerances are shown in Table 3. For combination of each part, assemble parts with the same selection code.

Table 1 Models of STSI series



## Accuracy

Table 2 Tolerance and allowance

Nominal dimensions of outside diameter of external cylinder mm		Tolerance of outside diameter of external cylinder $\mu\text{m}$		Radial runout of outside diameter of external cylinder $\mu\text{m}$	Tolerance of length of external cylinder and shaft mm
Over	Incl.	High	Low		
3	6	0	-5	8	$\pm 0.1$
6	10	0	-6		
10	18	0	-8		
18	30	0	-9	9	

Table 3 Selection code and tolerance unit:  $\mu\text{m}$

Selection code	Tolerance of bore diameter of external cylinder		Tolerance of inscribed circle diameter		Tolerance of shaft diameter	
	High	Low	High	Low	High	Low
M1	-1	-3	-1	-3	0	-1
M2	-2	-4	-2	-4	-1	-2
M3	-3	-5	-3	-5	-2	-3

## Load Rating

Load rating of the STSI series represents the value obtained when load is evenly distributed without the ball incorporated in the ball cage being dropped from the external cylinder and shaft end.

## Lubrication

Grease is not pre-packed in the STSI series, so please perform adequate lubrication as needed. Both of oil lubrication and grease lubrication are available in the STSI series. For grease lubrication, it is typically applied lightly to the shaft and raceway of the external cylinder. Use of high-quality lithium-soap base grease is recommended for the grease to use.

## Precaution for Use

### 1 Fitting

The STSI series is assembled to slight preload state to obtain high motion accuracy. Use external cylinder and housing hole of the STSI series with clearance fit to avoid any effect of press-fitting on inscribed circle diameter. In addition, for combination of an external cylinder, a ball cage and a shaft, select an external cylinder and a shaft with the same selection code to be combined with a ball cage.

### 2 Operating temperature

The maximum operating temperature is 120°C and temperature up to 100°C is allowed for continuous operation. When the temperature exceeds 100°C, contact IKO.

### 3 Mounting






Typically, to fix the external cylinder and housing hole, the external cylinder end is fixed to the axial direction with stop ring or adhesive agent is used.

The ball cage is mounted through the shaft after the external cylinder is fixed to the housing hole. At this point, mounting becomes easier if the ball cage is shifted by one half of assembly insertion amount of the shaft in insert direction of the shaft so that the ball cage is positioned at the regular position after mounting.

### 4 Insertion of shaft

When inserting a shaft into an external cylinder, be careful not to pry open or give shock to the shaft.

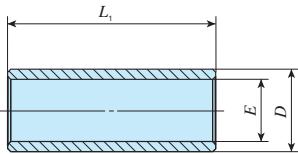
# IKO Miniature Stroke Rotary Bushing

	Assembled set with a shaft				Assembled set without a shaft				External cylinder				Ball cage				Shaft			
Shape	STSI				STS				OR...A				BK...A				SF...A			
																				
Size	2	3	4	5	2	3	4	5	2	3	4	5	2	3	4	5	2	3	4	5
	6	8	10	12	6	8	10	12	6	8	10	12	6	8	10	12	6	8	10	12

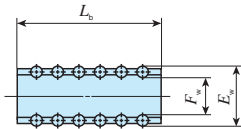
Shaft diameter  mm	Identification number of assembled set without a shaft	External cylinder					Ball cage			
		Identification number	Mass (Ref.)	Nominal dimensions mm			Identification number	Mass (Ref.)	$F_w$	
			g	$E$	$D$	$L_1$		g		
2	STS 2 $L_1$ - $L_b$	OR 3 5 10 A OR 3 5 15 A	0.9 1.3	3.2	5	10 15	BK 2 3 5 A BK 2 3 10 A	0.1 0.3	2	
3	STS 3 $L_1$ - $L_b$	OR 5 7 10 A OR 5 7 20 A OR 5 7 30 A	1.5 2.9 4.4	5	7	10 20 30	BK 3 5 10 A BK 3 5 15 A BK 3 5 20 A	0.7 1.1 1.4	3	
4	STS 4 $L_1$ - $L_b$	OR 6 8 10 A OR 6 8 20 A OR 6 8 30 A	1.7 3.4 5.2	6	8	10 20 30	BK 4 6 10 A BK 4 6 15 A BK 4 6 20 A	0.9 1.3 1.8	4	
5	STS 5 $L_1$ - $L_b$	OR 7 10 10 A OR 7 10 20 A OR 7 10 30 A	3.1 6.3 9.4	7	10	10 20 30	BK 5 7 10 A BK 5 7 15 A BK 5 7 20 A	1.0 1.6 2.0	5	
6	STS 6 $L_1$ - $L_b$	OR 8 11 20 A OR 8 11 30 A OR 8 11 40 A	7.0 10.5 14.1	8	11	20 30 40	BK 6 8 10 A BK 6 8 15 A BK 6 8 20 A	1.2 1.8 2.3	6	
8	STS 8 $L_1$ - $L_b$	OR 10 13 20 A OR 10 13 30 A OR 10 13 40 A	8.5 12.7 17.0	10	13	20 30 40	BK 8 10 10 A BK 8 10 15 A BK 8 10 20 A	1.6 2.4 3.2	8	
10	STS 10 $L_1$ - $L_b$	OR 12 18 20 A OR 12 18 30 A OR 12 18 43 A	22.2 33.3 47.7	12	18	20 30 43	BK 10 12 15 A BK 10 12 20 A BK 10 12 25 A	2.8 3.8 4.8	10	
12	STS 12 $L_1$ - $L_b$	OR 14 20 25 A OR 14 20 30 A OR 14 20 35 A OR 14 20 40 A	31.4 37.7 44.0 50.3	14	20	25 30 35 40	BK 12 14 20 A BK 12 14 25 A BK 12 14 30 A	4.3 5.4 6.1	12	

Note (¹) Represents the value when load is evenly distributed without the ball incorporated in the ball cage being dropped from the external cylinder end.

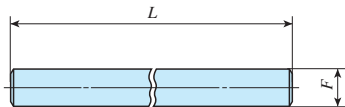
Remark:  $L_1$ ,  $L_b$ , and  $L$  in the identification number field of assembled set without a shaft and assembled set with a shaft represent length of the external cylinder, length of the ball cage, and length of the shaft in the dimension table.



External cylinder



Ball cage



Shaft

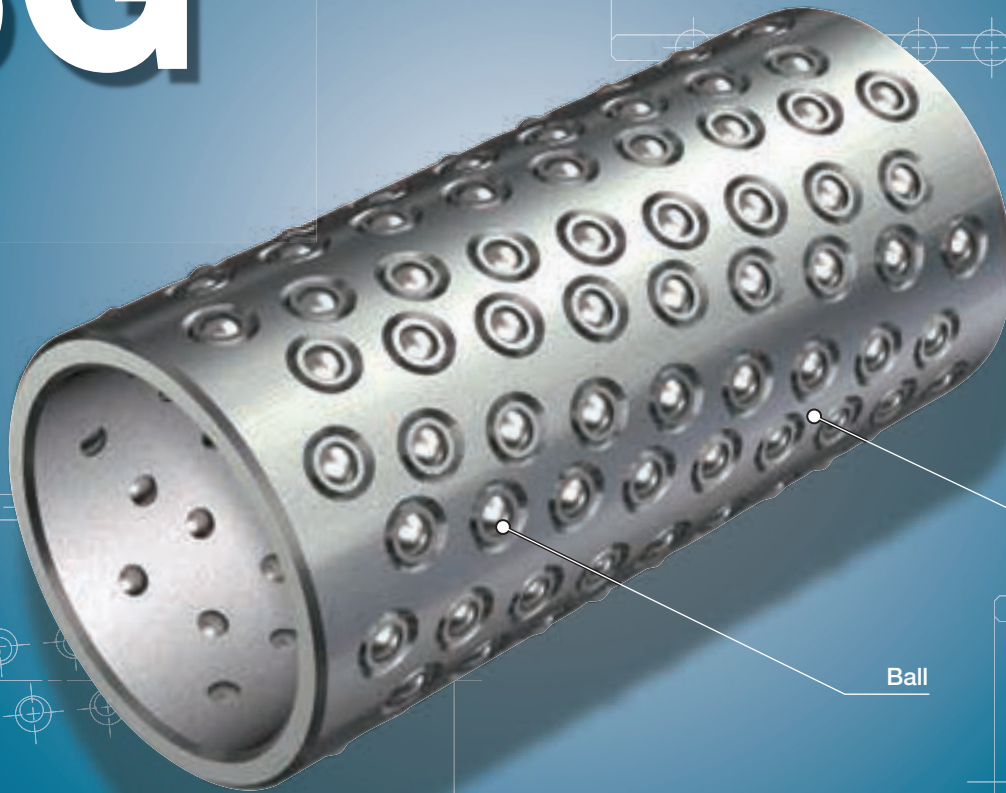
Nominal dimensions mm			Basic static load rating <sup>(1)</sup>  C <sub>0</sub> N	Shaft				Identification number of assembled set with a shaft
				Identification number	Mass (Ref.) g	Nominal dimensions mm		
	E <sub>w</sub>	L <sub>b</sub>				F	L	
	3.2	5	10.5	SF 2 20 A	0.5	2	20	STSI 2 L <sub>1</sub> -L <sub>b</sub> -L
		10	21.0	SF 2 30 A	0.7		30	
	5	10	38.4	SF 3 50 A	2.8	3	50	STSI 3 L <sub>1</sub> -L <sub>b</sub> -L
		15	57.7	SF 3 60 A	3.3		60	
		20	76.9					
	6	10	59.5	SF 4 50 A	4.9	4	50	STSI 4 L <sub>1</sub> -L <sub>b</sub> -L
		15	89.3	SF 4 60 A	5.9		60	
		20	119					
	7	10	81	SF 5 50 A	7.7	5	50	STSI 5 L <sub>1</sub> -L <sub>b</sub> -L
		15	121	SF 5 80 A	12.3		80	
		20	162					
	8	10	103	SF 6 50 A	11.1	6	50	STSI 6 L <sub>1</sub> -L <sub>b</sub> -L
		15	154	SF 6 80 A	17.7		80	
		20	206					
	10	10	105	SF 8 50 A	19.7	8	50	STSI 8 L <sub>1</sub> -L <sub>b</sub> -L
		15	157	SF 8 80 A	31.5		80	
		20	209	SF 8 90 A	35.5		90	
	12	15	191	SF 10 80 A	49.3	10	80	STSI 10 L <sub>1</sub> -L <sub>b</sub> -L
		20	254	SF 10 100 A	61.6		100	
		25	318	SF 10 120 A	74.0		120	
	14	20	341	SF 12 80 A	71.0	12	80	STSI 12 L <sub>1</sub> -L <sub>b</sub> -L
		25	427	SF 12 100 A	88.8		100	
		30	512	SF 12 120 A	106.5		120	

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## Stroke Rotary Cage

# BG



Retainer

Ball

## Points

### ● Rotational and linear motions

High-accuracy balls incorporated into the retainer make use of the raceway accuracy to allow high-accuracy rotational motion and rotary and linear motion.

### ● Superior high speed operation

As the retainers have high rigidity and light in weight with low inertia, this series is suitable for abrupt operations such as high-speed rotary and linear motion in axial direction.

### ● Large load rating and high rigidity

In the retainer, balls are incorporated as many as possible. So the load ratings are large and the rigidity is high with small elastic deformation even under fluctuating load or offset load.

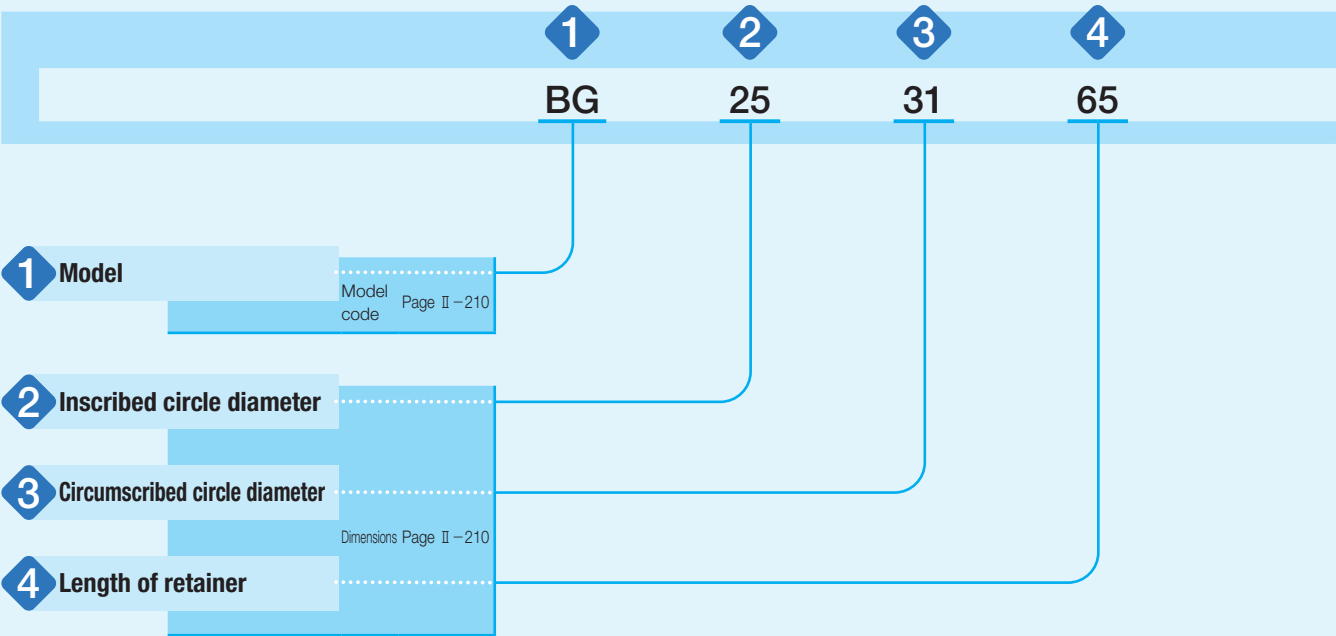
### ● Long life

Each ball held in the retainer is arranged in a spiral formation in order to prevent the balls from tracing the same path. Rolling contact fatigue of the shaft and housing raceways is thereby minimized, and stable high accuracy can be assured for long periods of time.

## Identification Number and Specification

### Example of an identification number

The specification of BG series is indicated by the identification number. Indicate the identification number, consisting of a model code and dimensions.



## Identification Number and Specification

1 Model	Stroke Rotary Cage (BG series)	: BG
2 Inscribed circle diameter		Indicate the inscribed circle diameter in mm.
3 Circumscribed circle diameter		Indicate the circumscribed circle diameter in mm.
4 Length of retainer		Indicate the length of retainer in mm.

## Allowance of Velocity

The BG series is capable of rotation and rotary and linear motion. However, allowance of velocity for these motions performed at the same time is obtained from the equation (1). Typical values are indicated in Table 1.

$$DN \geq D_{pw} n + 10 S n_1 \dots \dots \dots (1)$$

- where, *DN* : Allowance of velocity (see Table 1)  
*n* : Rotational speed, min<sup>-1</sup>  
*n*<sub>1</sub> : Number of strokes per minute, min<sup>-1</sup>  
*S* : Stroke length, mm  
*D*<sub>pw</sub> : Pitch circle diameter of balls, mm  
 $\left(D_{pw} = \frac{F_w + E_w}{2}\right)$   
*F*<sub>w</sub> : Inscribed circle diameter, mm  
*E*<sub>w</sub> : Circumscribed circle diameter, mm

However, applicable when *n*<sub>1</sub> ≤ 5000, *S n*<sub>1</sub> ≤ 50000.

Table 1 Allowance of velocity

Lubrication conditions	DN
Oil lubrication	600 000
Grease lubrication	300 000



# Precaution for Use

## ① Fitting

BG series is generally used with a slight radial internal clearance fit. Recommended fits are shown in Table 2. When it is used for a guide post of the press die set or high operation accuracy is required, a preload is generally given. The tolerances of dimensions of the shaft and housing bore in this case are shown in Table 3. However, since excessive preload shortens the life of Stroke Rotary Cage, it is suggested that the lower limit of radial clearance is not smaller than the value shown in Table 4.

Table 2 General fit

Tolerance class	
Shaft	Housing hole
h5, h6	H6, H7

Table 3 Tolerances of dimensions for shaft and housing hole unit: μm

Shaft			Housing hole		
Nominal dimensions mm	h5		Nominal dimensions mm	K5	
	H	L		H	L
19	0	− 9	25	+1	−8
22	0	− 9	28	+1	−8
25	0	− 9	31	+2	−9
28	0	− 9	36	+2	−9
32	0	−11	40	+2	−9
38	0	−11	48	+2	−9

Table 4 Lower limit of radial internal clearance unit: μm

Nominal dimensions of shaft mm	Lower limit of radial internal clearance
19	−5
22	−5
25	−5
28	−7
32	−7
38	−7

## ② Raceway

BG series is used with a shaft and housing hole as raceway surfaces. Recommended values for surface hardness and roughness of mating raceway are shown in Table 5 and the recommended values for the minimum effective hardening depth are shown in Table 6. When some of the balls held in the retainer escape the housing raceway and operate in linear motion, it is recommended that the housing raceway ends should be slightly chamfered so that the balls enter or exit smoothly.

Table 5 Surface hardness and roughness of raceway

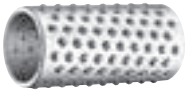
Item	Recommended value	Remark
Surface hardness	58~64HRC	When the surface hardness is low, multiply the load rating by hardness factor (¹) .
Surface roughness	0.2 μmRa or lower (0.8 μmRy or lower)	Where accuracy standard is low, around 0.8 μmRa (3.2 μmRy) is also allowed.

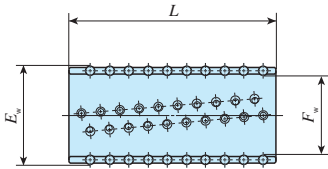
Note (¹) For hardness factor, refer to Fig. 3 in page III-5.

Table 6 Minimum effective hardening depth of raceway unit: mm

Nominal dimensions of shaft and housing hole		Recommended value for minimum effective hardening depth
Over	Incl.	
—	28	0.8
28	50	1.0

# IKO Stroke Rotary Cage

Shape	BG		
			
Size	19	22	25
	28	32	38



Shaft diameter mm	Identification number	Mass (Ref.) g	Nominal dimensions			Basic dynamic load rating <sup>(1)</sup>	Basic static load rating <sup>(1)</sup>
			mm			C	C <sub>0</sub>
			F <sub>w</sub>	E <sub>w</sub>	L	N	N
19	BG 192555*	33	19	25	55	2 330	2 600
22	BG 222860*	40	22	28	60	2 490	2 950
25	BG 253165*	48	25	31	65	2 660	3 390
28	BG 283670*	76	28	36	70	3 830	4 660
32	BG 324075*	93	32	40	75	4 480	6 030
38	BG 384880*	162	38	48	80	6 750	9 390

Note <sup>(1)</sup> Basic dynamic load rating and basic static load rating are values when balls incorporated into the retainer share the load evenly without escaping the raceway.  
Remark: The identification numbers with \* are our semi-standard items.

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