THK

NEW

Caged Ball™

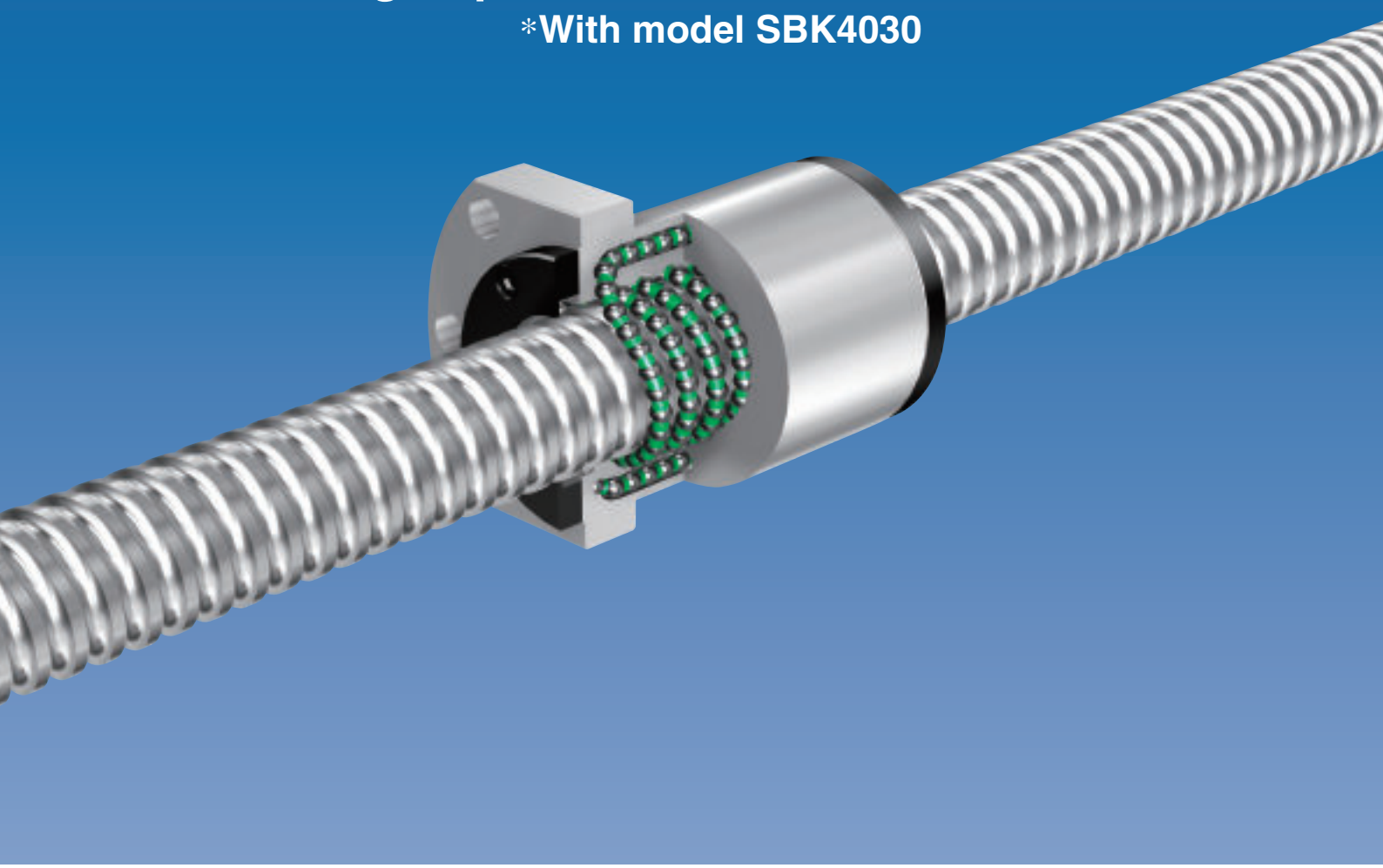
High-Speed Caged Ball Screw Model SBK

Low noise, long-term maintenance-free operation
High speed, high accuracy
DN value: 160,000

SBK

Achieves high-speed feed at 114 m/min

*With model SBK4030



For details, visit THK at **www.thk.com**

*Product information is updated regularly on the THK website.

THK CO., LTD.
TOKYO. JAPAN

CATALOG No.307-3E

High-Speed Caged Ball Screw

SBK

Stress-free, ideal circulation structure

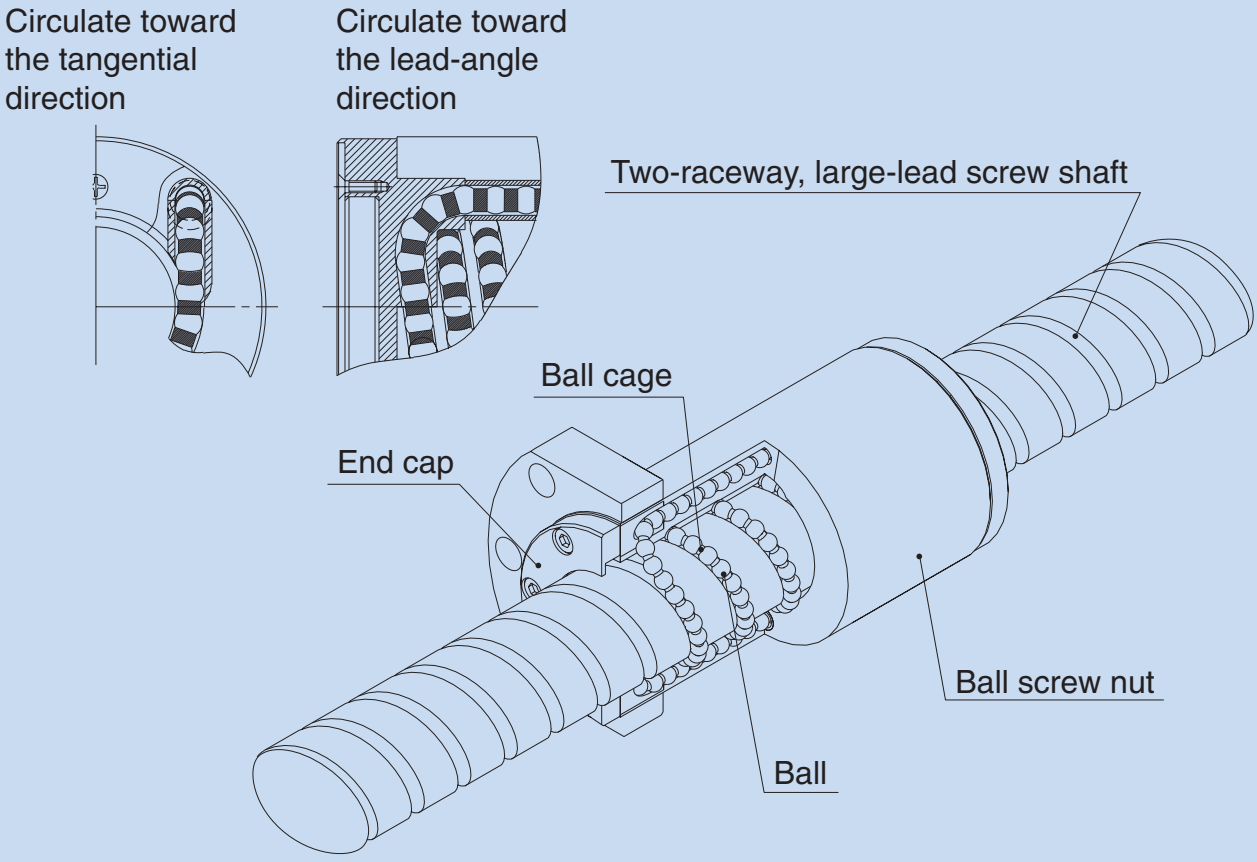


Fig. 1 Structural Drawing of Model SBK

Structure

With High-Speed Caged Ball Screw model SBK, balls are evenly spaced by a ball cage to eliminate collision and friction between the balls and ensure a high level of grease retention. As a result, low noise, low torque fluctuation and long-term maintenance-free operation are achieved.
In addition, this model has an ideal circulation structure where balls are picked up at the tangential direction (Fig. 2), thus to achieve a DN value* of 160,000 (* DN value = ball center diameter × rotation speed per minute) in high-speed operation.
As a result of adopting a method to provide a phase difference between the two raceways of the nut, its overall ball screw nut length is shorter and its body is more compact than the double-nut type, which uses the spacer-based preloading method.

Features

●Superbly high speed

Use of a circulation structure in which balls are picked up in the tangential direction and the lead-angle direction by end caps (Fig. 2) enables the Ball Screw to be used in high speed operation at a DN value of 160,000, thus to achieve high-speed feed 2.2 times faster than the conventional type.

●Smooth motion

Use of a ball cage eliminates friction between balls (Fig. 4) and minimizes torque fluctuation, thus allowing smooth motion to be achieved.

●Long-term maintenance-free operation

Increased grease retention through formation of grease pockets (Fig. 4) ensures long-term maintenance-free operation.

●Low noise, acceptable running sound

Use of a ball cage placed to prevent each ball from contacting the adjacent ball eliminates collision noise between the balls (Fig. 4). In addition, the circulation structure where balls are picked up at the tangential direction (Fig. 2) also contributes to eliminating collision noise generated from circulating balls and decreases a noise level.

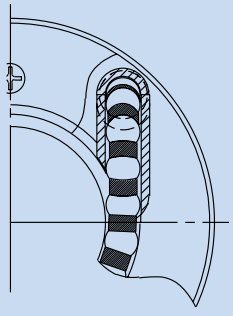
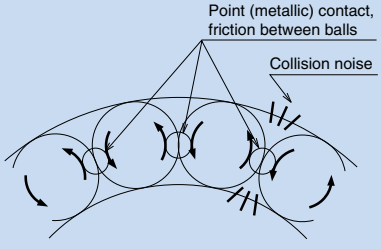
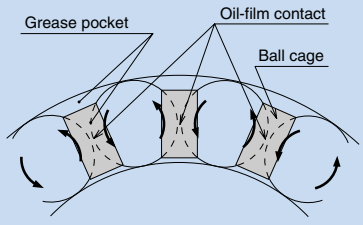


Fig .2



Conventional structure

Fig. 3



Structure of a ball cage

Fig. 4

■Superbly high speed

Conditions

Sample	SBK4030-7.6
Rotation speed	3800(min^{-1}) (DN value: 160,000)
Stroke	700mm
Load	2.3kN
Acceleration	1G
Lubrication	Multemp HRL Grease + QZ Lubricator (oil grease)

Result

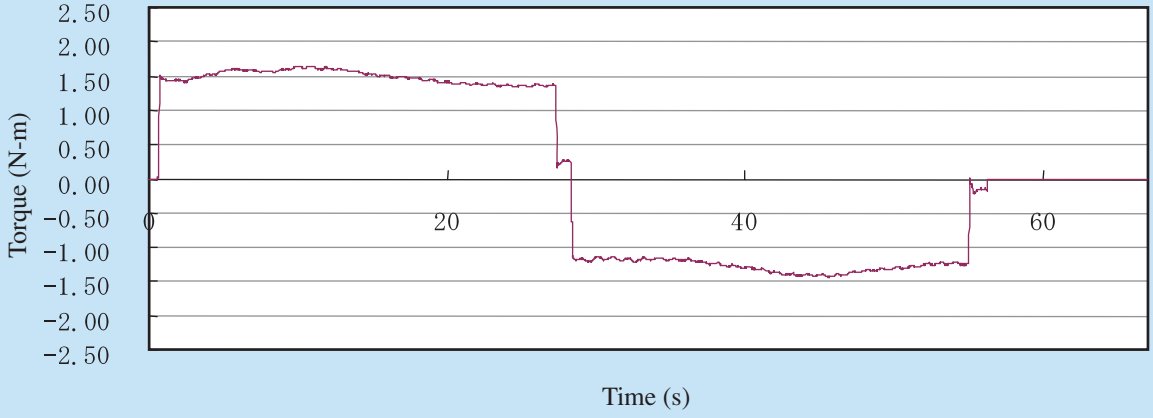
Normally operates after running 7,000 km without any anomaly.

■Smooth motion

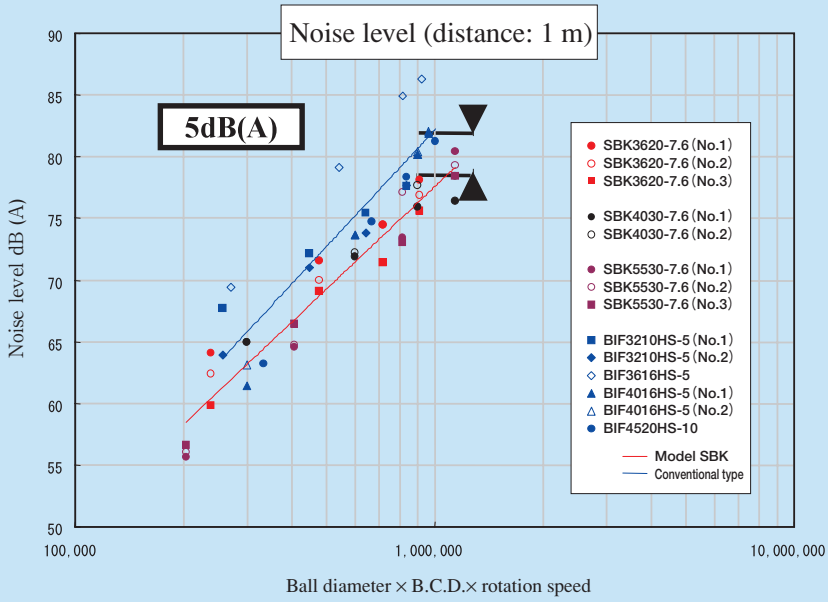
Conditions

Rotation speed	60min^{-1}
Stroke	800mm
Lubrication	Multemp HRL Grease

SBK4030-7.6



■Lownoise



Result

A noise level 5 dB (A) lower than the conventional type is achieved.

Accuracy Standards

THK High-Speed Caged Ball Screw is manufactured with accuracy compliant with JISB1192 (precision Ball Screw). This model can be manufactured with up to the maximum accuracy of C0 grade. In terms of lead accuracy measurement, the lead accuracy is assured with a laser measurement machine, whose reliability is proven. For details of the standard values, see the General Catalog.

Static Safety Factor

The basic static load rating C_0a

The basic static load rating (C_0a) generally equals to the permissible axial load of a Ball Screw. Depending on the conditions, it is necessary to take into account the following static safety factor against the calculated load. When the Ball Screw is stationary or in motion, unexpected external force may be applied through an inertia caused by the impact or the start and stop.

■Static safety factor

$$Fa_{max} = \frac{C_0a}{f_s}$$

Fa_{max} : Permissible Axial Load [kN]
C_0a : Basic static load rating [kN]
f_s : Static safety factor (see Table 1)

Table 1 Static Safety Factor (f_s)

Machine using the LM system	Load conditions	Lower limit of f_s
General industrial machinery	Without vibration or impact	1.0 to 3.5
	With vibration or impact	2.0 to 5.0
Machine tool	Without vibration or impact	1.0 to 4.0
	With vibration or impact	2.5 to 7.0

The basic static load rating (C_0a) is a static load with a constant direction and magnitude whereby the sum of the permanent deformation of the rolling element and that of the raceway on the contact area under the maximum stress is 0.0001 times the rolling element diameter. With the Ball Screw, it is defined as the axial load. (Specific values of each Ball Screw model are indicated in the specification tables for the corresponding model number.)

Rated Life and Service Life Time

Basic dynamic load rating Ca

The basic dynamic load rating (Ca) is used in calculating the service life when a Ball Screw operates under a load. The basic dynamic load rating is a load with interlocked direction and magnitude under which the nominal life (L) equals to 10^6rev. when a group of the same Ball Screw units independently operate. (Specific basic dynamic load ratings (Ca) are indicated in the specification tables of the corresponding model numbers.)

■Rated Life

The service life of the Ball Screw is calculated from the following equation using the basic dynamic load rating (Ca) and the applied axial load.

● Nominal Life (Total Number of Revolutions)

$$L = \left(\frac{Ca}{f_w \cdot Fa} \right)^3 \times 10^6$$

L	:	Nominal life (total number of revolutions)	[rev]
Ca	:	Basic dynamic load rating	[N]
Fa	:	Applied axial load	[N]
f_w	:	Load factor	(see Table 2)

Table 2 Load Factor (f_w)

Vibrations/ impact	Speed (V)	f_w
Faint	Very low V≦0.25 m/s	1 to 1.2
Weak	Slow 0.25＜V≦ 1 m/s	1.2 to 1.5
Medium	Medium 1＜V≦ 2 m/s	1.5 to 2
Strong	High V＞2 m/s	2 to 3.5

* For the rated service life, the load is calculated under condition that proper lubrication is applied and products are mounted within the suggested alignment values. The mounting components and surface are not prepared correctly, it can have adverse affect on the service life.

■Service Life Time

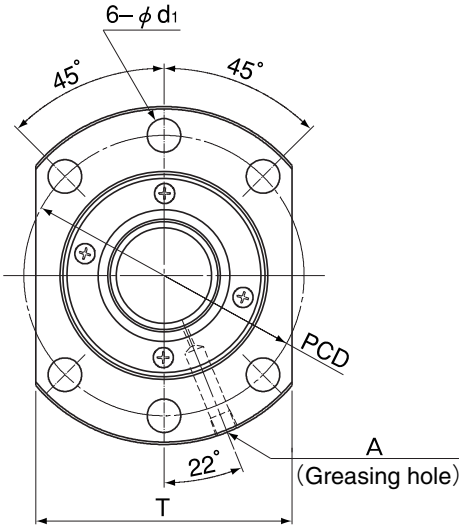
If the revolutions per minute is determined, the service life time can be calculated from the following equation using the nominal life (L).

$$L_h = \frac{L}{60 \times N} = \frac{L \times Ph}{2 \times 60 \times n \times \ell_s}$$

L_h	:	Service life time	[h]
N	:	Revolutions per minute	[min^{-1}]
n	:	Number of reciprocations per minute	[min^{-1}]
Ph	:	Ball Screw lead	[mm]
ℓ_s	:	Stroke length	[mm]

MEMO

Dimensional Table for Model SBK



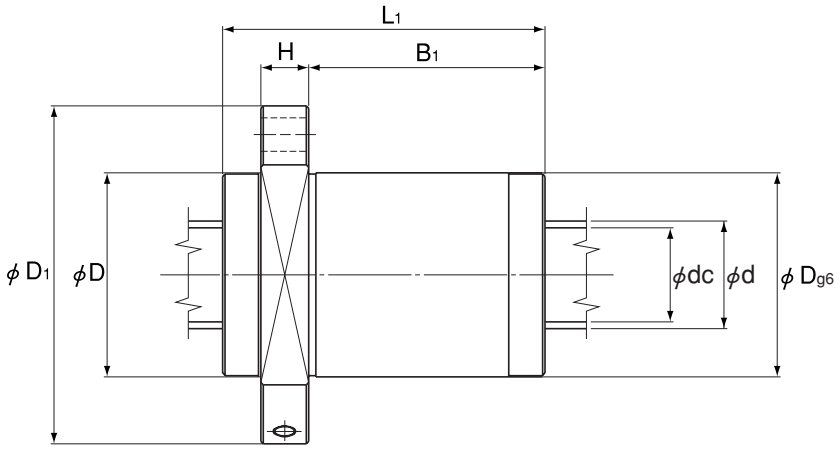
Model No.	Screw shaft outer diameter d	Lead Ph	Ball center-to-center diameter dp	Thread minor diameter dc	No. of loaded circuits Rows × turns	Basic load rating Ca [kN]	Basic load rating C0a [kN]	Rigidity K [N/μm]
SBK 3620-7.6	36	20	37.75	30.4	1×3.8	48.5	85	870
SBK 4020-7.6	40	20	42	34.1	1×3.8	59.7	112.7	970
SBK 4030-7.6	40	30	42	34.1	1×3.8	59.2	107.5	970
SBK 5020-7.6	50	20	52	44.1	1×3.8	66.8	141.9	1170
SBK 5030-7.6	50	30	52	44.1	1×3.8	66.5	135	1170
SBK 5036-7.6	50	36	52	44.1	1×3.8	65.9	135	1170
SBK 5520-7.6	55	20	57	49.1	1×3.8	69.8	156.4	1250
SBK 5530-7.6	55	30	57	49.1	1×3.8	69.2	147	1250
SBK 5536-7.6	55	36	57	49.1	1×3.8	69.1	148.7	1260

Note: With model SBK, the raising of both ends of the thread groove is not available. When designing your system this way, contact THK.

Example of model number coding

SBK3620-7.6 QZ RR G0 + 1500L C5
① ② ③ ④ ⑤ ⑥

① Model number ② With QZ Lubricator (without QZ Lubricator: no symbol)
③ Seal symbol (RR: labyrinth seal on both ends; WW: wiper ring on both ends)
④ Axial clearance symbol
⑤ Overall screw shaft length (in mm) ⑥ Accuracy symbol



Unit: mm

Nut dimensions									Screw shaft inertial moment/mm [kg • cm²/mm]	Nut mass [kg]	Shaft mass [kg/m]
Outer diameter D	Flange diameter D1	Overall length L1	H	B1	PCD	d1	Tw	Greasing hole A			
73	114	110	18	81	93	11	86	PT1/8	1.29×10^{-2}	3.4	5.0
80	136	110	20	79	112	14	103	PT1/8	1.97×10^{-2}	4.5	5.7
80	136	148	20	117	112	14	103	PT1/8	1.97×10^{-2}	5.6	7.0
90	146	110	22	77	122	14	110	PT1/8	4.82×10^{-2}	5.3	10.2
90	146	149	22	116	122	14	110	PT1/8	4.82×10^{-2}	6.6	11.9
90	146	172	22	139	122	14	110	PT1/8	4.82×10^{-2}	7.4	12.5
96	152	110	22	77	128	14	114	PT1/8	7.05×10^{-2}	5.7	13.0
96	152	149	22	116	128	14	114	PT1/8	7.05×10^{-2}	7.2	14.8
96	152	172	22	139	128	14	114	PT1/8	7.05×10^{-2}	8.1	15.5

Note: The rigidity values in the table represent spring constants each obtained from the load and the elastic displacement when providing a preload 10% of the basic dynamic load rating (Ca) and applying an axial load three times greater than the preload. These values do not include the rigidity of the components related to mounting the ball screw nut. Therefore, it is normally appropriate to regard roughly 80% of the value in the table as the actual value.
If the applied preload (Fa_0) is not 0.1 Ca, the rigidity value (K_N) is obtained from the following equation.

$$K_N = K\left(\frac{Fa_0}{0.1Ca}\right)^{\frac{1}{3}}$$

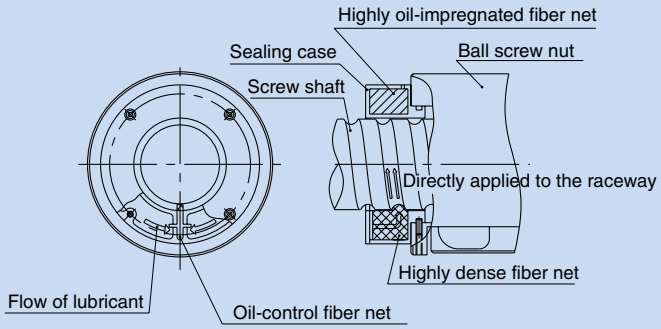
K : Rigidity value in the dimensional table.

Options

For model SBK, two options are available to achieve long-term maintenance-free operation. Specifically, they are QZ Lubricator for Ball Screws, which contains a highly oil-impregnated fiber net, and Wiper Ring, which is a contact seal for Ball Screws highly capable of removing foreign matter.

■QZ Lubricator

QZ Lubricator feeds a right amount of lubricant to the ball raceway of the ball screw shaft. This allows an oil film to be constantly formed between the balls and the raceway, improves lubrications and significantly extends the lubrication maintenance interval.
The structure of QZ Lubricator consists of three major components: (1) a heavily oil-impregnated fiber net (stores the lubricant), (2) a high-density fiber net (applies the lubricant to the raceway) and (3) an oil-control plate (adjusts the oil flow). The lubricant contained in the QZ Lubricator is fed by the capillary phenomenon, which is used also in felt pens and many other products.



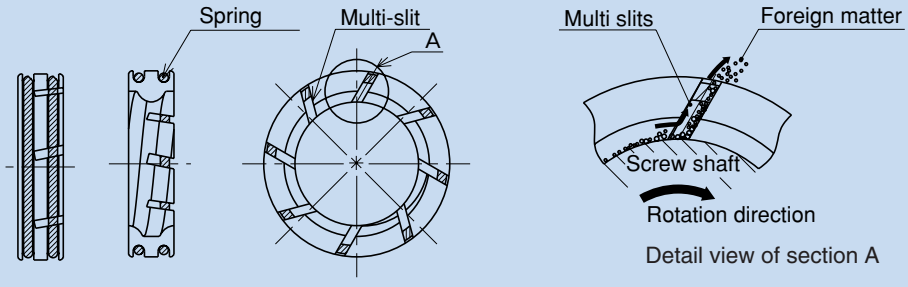
<Features>

- Since it supplements an oil loss, the lubrication maintenance interval can be significantly extended.
- Since the right amount of lubricant is applied to the ball raceway, an environmentally friendly lubrication system that does not contaminate the surroundings is achieved.

Note) QZ Lubricator has a vent hole. Do not block the hole with grease or the like.

■Wiper Ring

With the wiper ring W, special resin with a high wear resistance and a low dust generation which removes and prevents foreign materials from entering the ball screw nut while elastically contacting the circumference of the ball screw shaft and the screw thread.

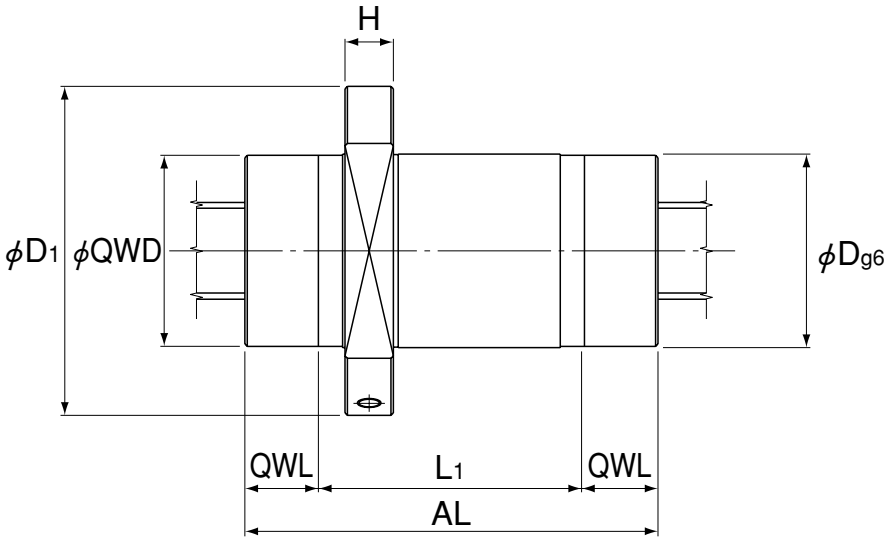


Structural drawing of the wiper ring

<Features>

- A total of eight slits on the circumference remove foreign materials in succession, and prevent entrance of foreign material.
- Contacts the ball screw shaft to reduce the flowing out of grease.
- Contacts the ball screw shaft at a constant pressure level using a spring, thus to minimize the heat generation.
- Since the material is highly resistant to the wear and the chemicals, its performance will not easily be deteriorated even if it is used over a long period.

The Ball Screw Nut Dimensions with the Wiper Ring (WW) and QZ Lubricator (QZ) Attached



Unit: mm

Model No.	Dimensions with WW attached				Dimensions with QZWW attached		
	Length L_1	Flange width H	Flange diameter D_1	Outer diameter D	Length QWL	Outer diameter QWD	Overall length AL
SBK3620-7.6	110	18	114	73	28	69	166
SBK4020-7.6	110	20	136	80	30.5	79	171
SBK4030-7.6	148	20	136	80	30.4	79	208.8
SBK5020-7.6	110	22	146	90	35	89	180
SBK5030-7.6	149	22	146	90	35	89	219
SBK5036-7.6	172	22	146	90	35	89	242
SBK5520-7.6	110	22	152	96	32	95	174
SBK5530-7.6	149	22	152	96	32	95	213
SBK5536-7.6	172	22	152	96	32	95	236

Precautions on Using THK High-Speed Caged Ball Screw Model SBK

⚠ Precautions on Use

●Handling

- Disassembling components may cause dust to enter the system or degrade mounting accuracy of parts. Do not disassemble the product.
- Tilting the screw shaft and the ball screw nut may cause them to fall by their self-weights.
- Dropping or hitting the Ball Screw may damage the ball circulation section, which may cause functional loss. Giving an impact to the product could also cause damage to its function even if the product looks intact.

●Lubrication

- Thoroughly remove anti-corrosion oil and feed lubricant before using the product.
- Do not mix lubricants of different physical properties.
- In locations exposed to constant vibrations or in special environments such as clean rooms, vacuum and low/high temperature, normal lubricants may not be used. Contact THK for details.
- When planning to use a special lubricant, contact THK before using it.
- Lubrication interval varies according to the service conditions. Contac THK for details.

●Precautions on Use

- Do not remove the ball screw nut from the screw shaft. Doing so may cause the balls or the ball cage to fall off.
- Entrance of foreign matter to the ball screw nut may cause damage to the ball circulating path or functional loss. Prevent foreign matter, such as dust or cutting chips, from entering the system.
- If foreign matter adheres to the product, replenish the lubricant after cleaning the product. For the type of cleaning liquid, contact THK .
- Use a cover or the like to prevent the coolant from entering the ball screw nut.
- Do not use the product at temperature of 80°C or higher. When desiring to use the system at temperature of 80°C or higher, contact THK in advance.
- If using the product with vertical mount, the ball screw nut may fall by its self-weight. Attach a mechanism to prevent it from falling.
- Using the product at speed exceeding the permissible rotation speed may cause breakage of a component or accident. Be sure to use the product within the specification range designated by THK
- Forcibly driving in the screw shaft or the ball screw nut may cause an indentation on the raceway. Use care when mounting components.
- If an offset or skewing occurs with the ball screw shaft support and the ball screw nut, it may substantially shorten the service life. Pay much attention to components to be mounted and to the mounting accuracy.
- When using the product in locations exposed to constant vibrations or in special environments such as clean rooms, vacuum and low/high temperature, contact THK in advance.
- Letting the ball screw nut overrun will cause balls to fall off or the ball-circulating component to be damaged. Be sure not to let it overrun.

●Storage

When storing the Ball Screw, enclose it in a package designated by THK and store it in a horizontal orientation while avoiding high temperature, low temperature and high humidity.

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