THK

NEW

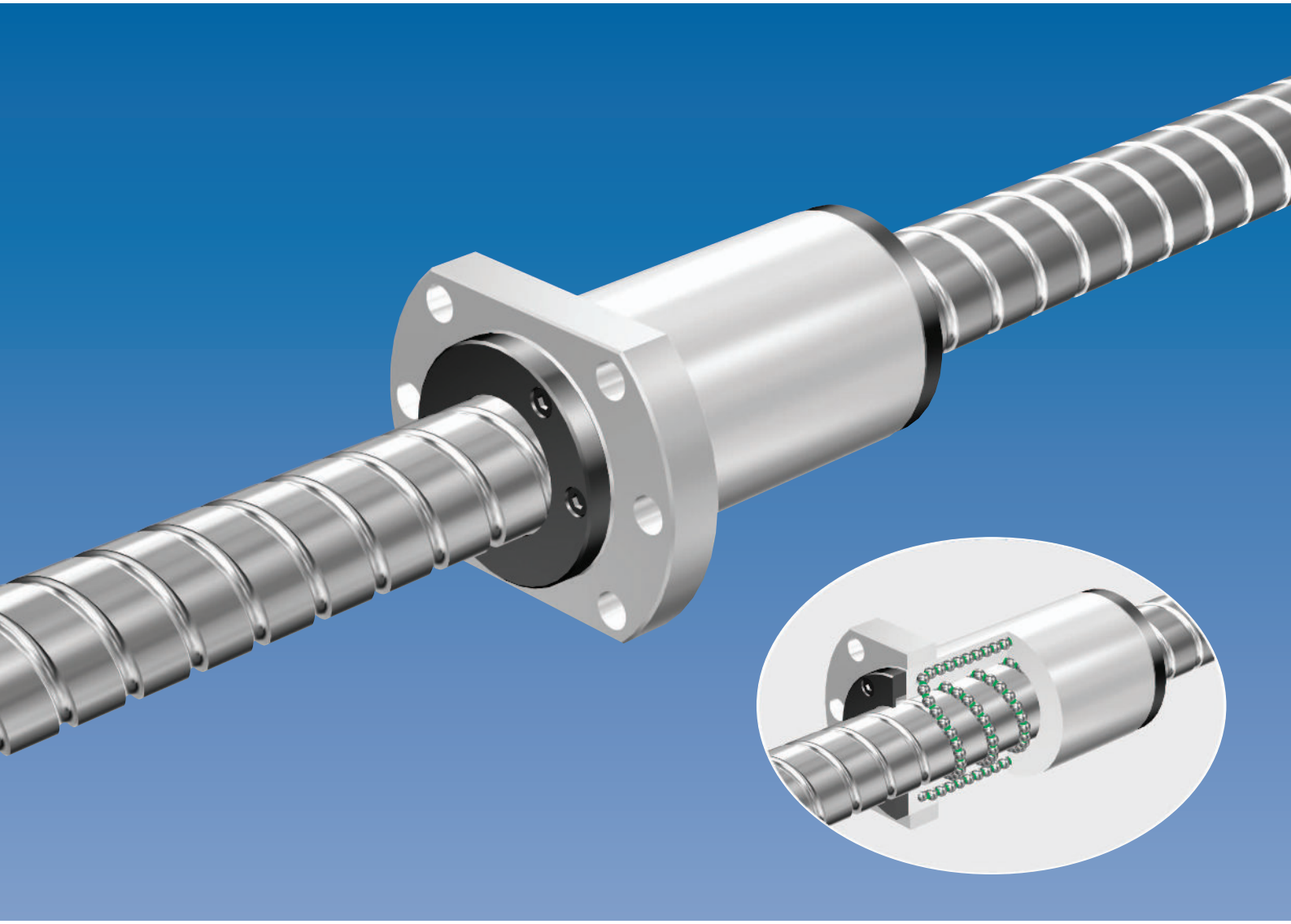
Large lead series

Caged Ball™

High-Speed Ball Screw with Caged Ball

DN value: 210,000 (Achieves high-speed feed at 200 m/min)
High-Speed feed by a large lead
Low noise, long-term maintenance-free operation

SBK



THK CO., LTD.
TOKYO, JAPAN

CATALOG No.330-2E

High-Speed Ball Screw with Caged ball technology

SBK

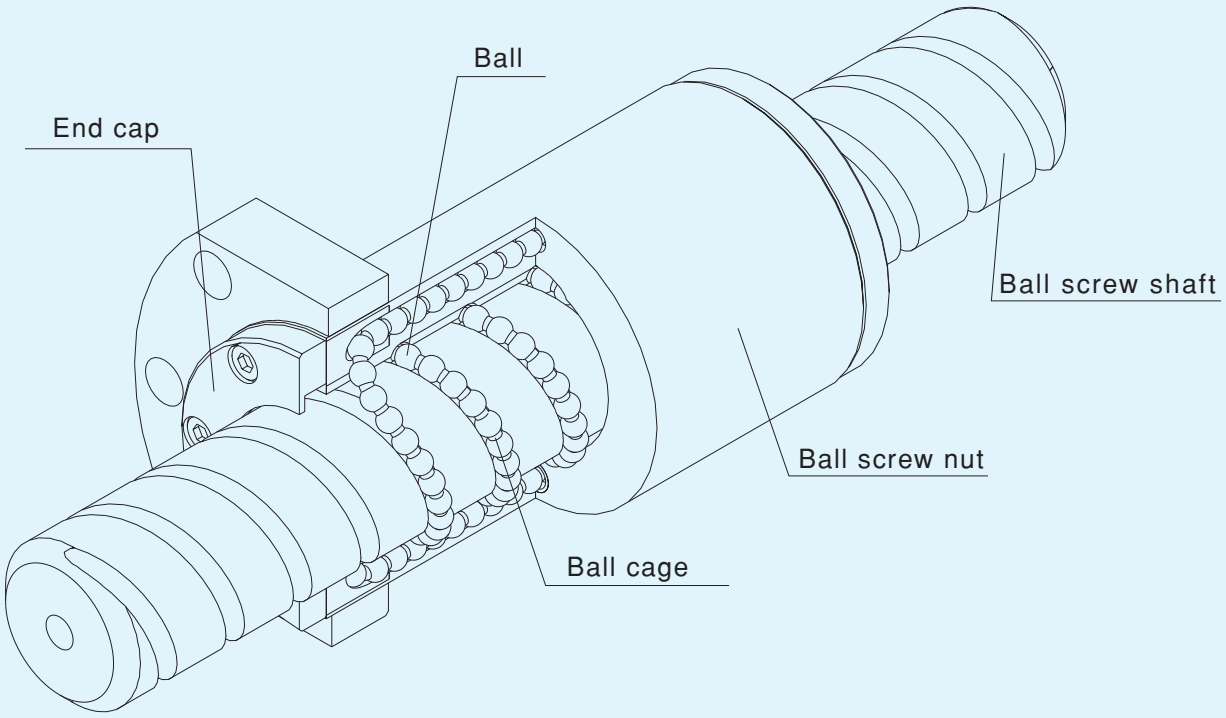


Fig.1 Structure of large lead SBK type

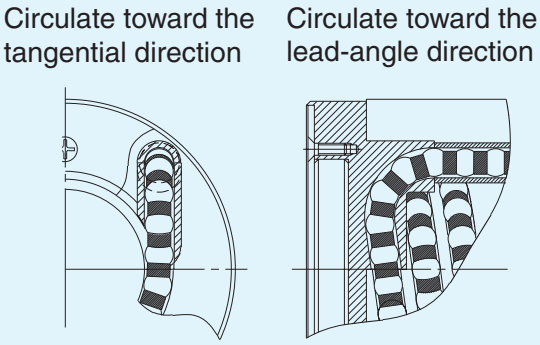


Fig.2 Ball circulation structure

Structure

High-Speed Ball Screw with Caged Ball 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, high-speed 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 210,000 (* DN value = ball center diameter × rotation speed per minute) in high-speed operation.

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. 3) enables the Ball Screw to be used in high speed operation at a DN value of 210,000, thus to achieve high-speed feed 200m/min faster than the conventional type.

●Smooth Motion

Use of a ball cage eliminates friction between balls (Fig. 5) 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. 5) 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. 5).
In addition, the circulation structure where balls are picked up at the tangential direction (Fig. 3) also contributes to eliminating collision noise generated from circulating balls and decreases a noise level.

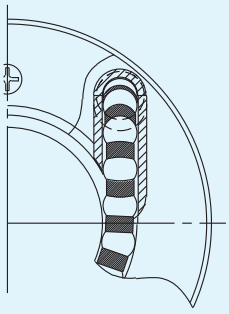
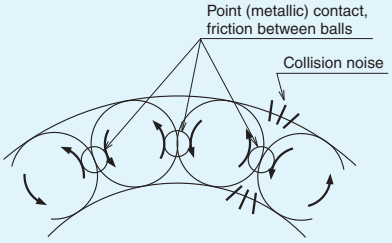
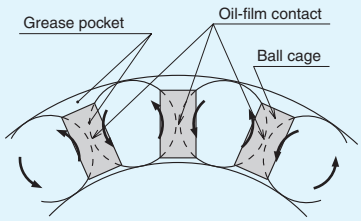


Fig. 3



Conventional structure

Fig. 4



Structure of a ball cage

Fig. 5

■ High Speed & Load Durability

A large lead SBK type uses a new re-circulation tube and caged ball technology to achieve smooth circulation which maintains high speed and improved load durability.

High speed durability test (In the case of DN value 210,000)

Test condition

Category	Data
Model number	SBK5050-5.6
Rotational speed	4000min^{-1}
Speed	200m / min
Stroke	800mm
Lubricant	AFJ grease
Apply	30cm^3 (applied every 500km)
Load	1.91kN
Acceleration	25.48m/s^2 (2.6G)

Test result

No problems after 5000km travel

Load durability test

Test condition

Category	Data
Model number	SBK3636-5.6
Rotational speed	1500min^{-1}
Speed	54m / min
Stroke	400mm
Lubricant	AFJ grease
Apply	15cm^3 (applied every 300km)
Load	13.9kN
Acceleration	34.3m/s^2 (3.5G)

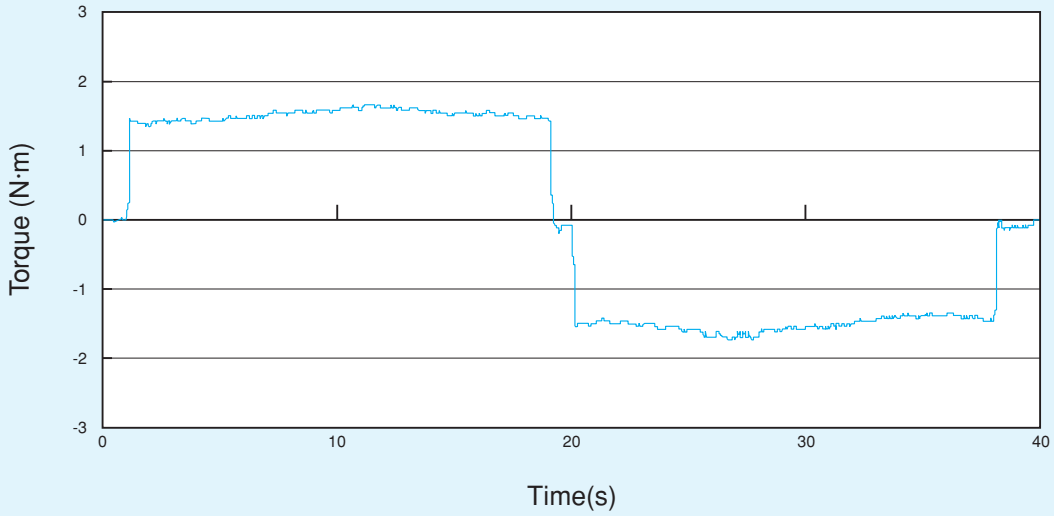
Test result

Operated for 2.5 times estimated life span without a problem (Currently in operation)

■ Smooth Rotation

A large lead SBK type uses caged ball technology, so it is possible to get smoother rotation compared to conventional types.

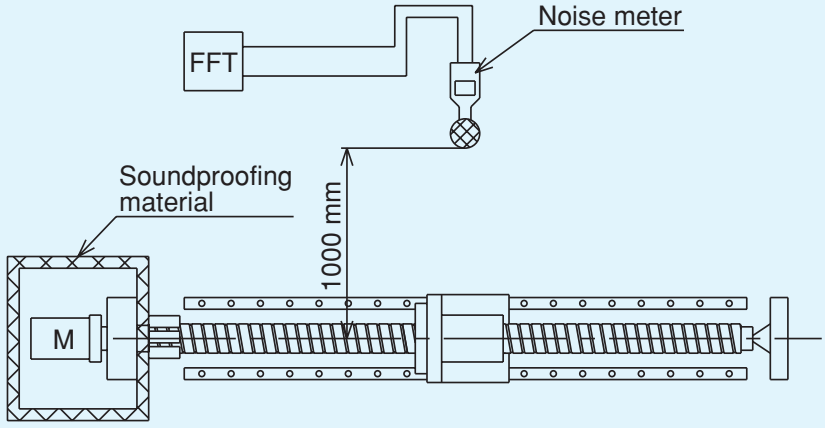
Category	Data
Model Number	SBK5050-5.6
Rotational speed	60min^{-1}



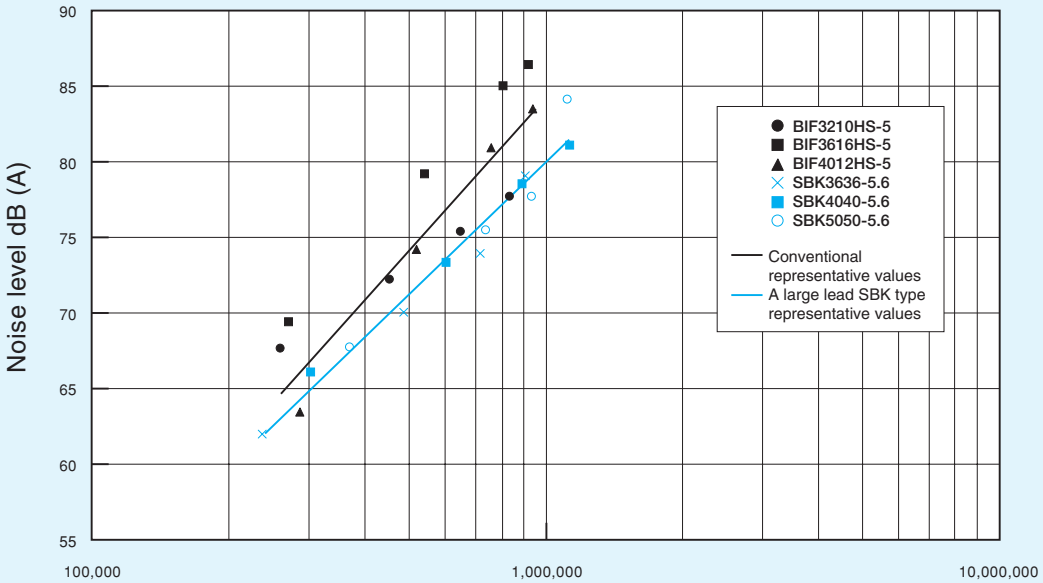
■ Low Noise

A large lead SBK type maintains quiet operation under high-speed rotation by adopting caged ball technology that eliminates collisions of adjacent metal balls.

Item	Description
Lubricator	AFJ grease
Measure distance	1m



Test equipment



Ball diameter × B.C.D × Rotational speed

Accuracy Standards

High-Speed Ball Screw with Caged Ball is manufactured with accuracy compliant with JIS B1192 (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

Basic Static Load Rating C0a

If a Ball Screw receives an excessive load or a large impact load while it is stationary or in motion, local permanent deformation occurs between the raceway and the steel ball. If the permanent deformation exceeds a certain limit, it will prevent smooth motion.

It is established that in general, if the permanent deformation is approximately 0.0001 times the steel ball diameter, there is no problem in operation at all. The load applied here is called a basic static load rating C0a. Depending on the service conditions, it is necessary to consider a static safety factor in the axial direction as indicated in table 1.

■ Static Safety Factor

$$fs \leqq \frac{C_{0a}}{Fa}$$

fs	:	Static safety factor	(table 1)
C_{0a}	:	Basic static load rating	[kN]
Fa	:	Applied axial load	[kN]

Table 1 Static Safety Factor

Machine used	Loading conditions	Lower limit of fs
General industry machine	Without vibration/impact	1.0 to 1.3
	With vibration/impact	2.0 to 3.0
Machine tool	Without vibration/impact	1.0 to 1.5
	With vibration/impact	2.5 to 7.0

Rated Life and Service Life Time

Basic Dynamic Load Rating Ca

The factor basic dynamic load rating Ca is used to calculate the service life of a Ball Screw when the ball screw nut operates under a load.

Basic dynamic load rating Ca refers to an axial load under which the rated load on 90% of a group of identical Ball Screw units independently operating is 10^6 rev (1 million revolutions).

■ Nominal life

The service life of a Ball Screw is obtained from the following equation using the basic dynamic load rating and the axial load.

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

L	:	Nominal life	[rev]
Ca	:	Basic dynamic load rating	[N]
Fa	:	Applied axial load	[N]
fw	:	Load factor	(table 2)

Table 2 Load Factor

Vibrations/impact	Speed (V)	fw
Faint	Very low V≦0.25 m/s	1.0 to 1.2
Weak	Low 0.25≦V≦ 1.0 m/s	1.2 to 1.5
Medium	Medium 1.0≦V≦ 2.0 m/s	1.5 to 2.0
Strong	High 2.0 m/s＜V	2.0 to 3.5

■ Service Life Time

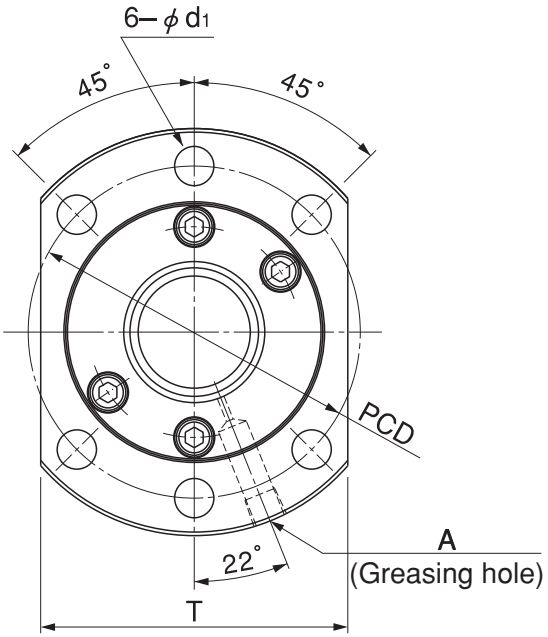
When the rated life L has been obtained, the service life time is calculated from the following equation if the stroke length and the number of reciprocations are constant.

$$Lh = \frac{L \times Ph}{2 \times \ell s \times n_1 \times 60}$$

Lh	:	Service life time	[h]
ℓs	:	Stroke length	[mm]
n_1	:	Revolutions per minute	[min^{-1}]
Ph	:	Ball Screw lead	[mm]

MEMO

Dimensional Table for Model SBK

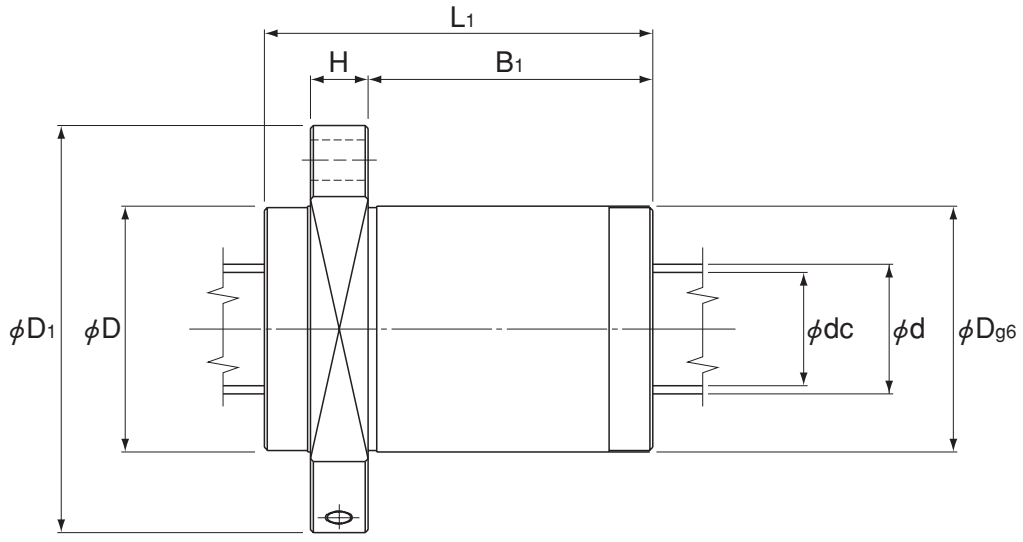


Model No.	Screw shaft outer diameter d	Lead Ph	No. of loaded circuits Rows × turns	Ball center-to-center diameter dp	Thread minor diameter dc	Basic load rating Ca [kN]	Basic load rating C0a [kN]	Rigidity K [N/μm]
SBK3636-5.6	36	36	1 × 2.8	37.75	31.4	36.6	64.7	460
SBK4040-5.6	40	40	1 × 2.8	42	34.9	44.8	80.3	520
SBK5050-5.6	50	50	1 × 2.8	52	44.9	50.3	102.4	630

Example of Model Number Coding

SBK3636-5.6 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

Outer diameter D	Flange diameter D1	Overall length L1	Nut dimensions H	B1	PCD	d1	T	Greasing hole A	Max permissible rotation speed [min^{-1}]	Screw shaft inertial moment/mm [kg·cm^2/mm]	Nut mass [kg]	Shaft mass [kg/m]
73	114	134	18	105	93	11	86	PT1/8	5560	1.29×10^{-2}	3.37	7.43
80	136	146	20	115	112	14	103	PT1/8	5000	1.97×10^{-2}	4.74	9.16
90	146	175	22	142	122	14	110	PT1/8	4030	4.82×10^{-2}	6.46	14.72

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.

●Note

With model SBK, the screw shaft cannot be threaded at both ends.

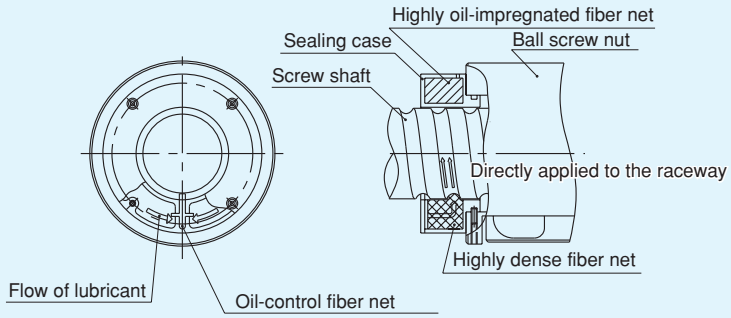
If designing SBK with threaded ends, contact THK.

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 is a new lubrication system capable of feeding the required amount of lubricant where it is needed.



<Features>

● Enables longer maintenance-free intervals

Normally, a small amount of oil is lost from ball screws during operation. By adding the lubricator QZ, oil lost over long periods is automatically replaced, greatly lengthening maintenance-free intervals.

● Lubricator QZ is environmentally conscious

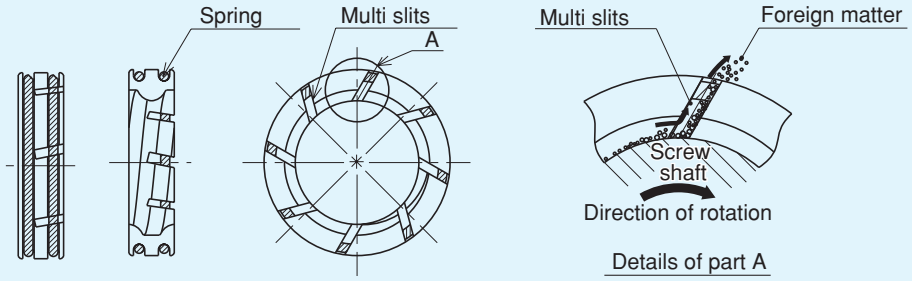
Because lubricator QZ uses a high-density fiber net to supply the appropriate amount of oil to the appropriate positions, there is no excess oil, making it an environmentally conscious design.

● The best oil for each application can be used

For further details contact THK.
(Applicable lubricating oil standard = ISO VG220)

■ Wiper Ring

With the wiper ring, a special resin with high wear resistance elastically contacts the shaft circumference and the thread groove, and eight slits remove the foreign matter, thus to prevent foreign matter from entering the ball screw nut.



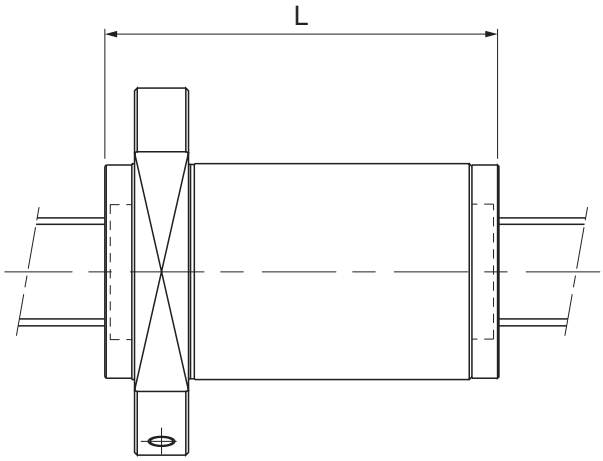
Structural drawing of the wiper ring

<Features>

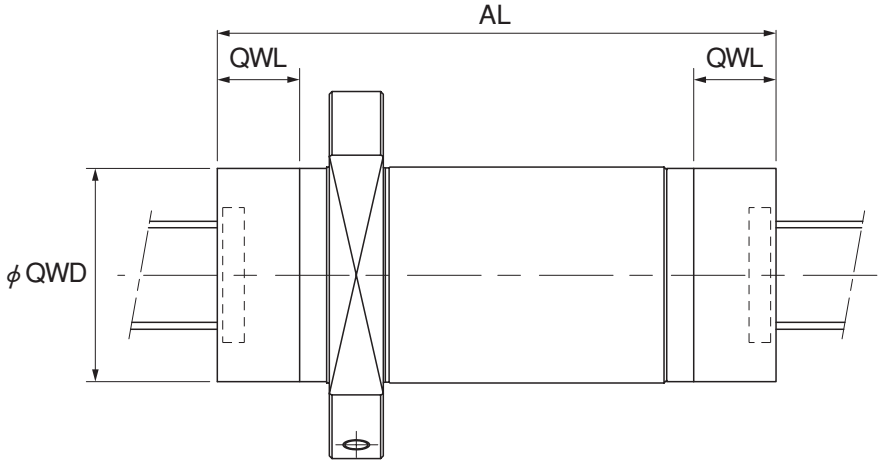
- Prevents foreign matter from entering the ball screw nut.
- Contacts the screw shaft at a constant pressure to minimize heat generation.
- Excels in wear resistance, impact resistance and chemical resistance.
- When attached to QZ Lubricator for the Ball Screw, it significantly extends the maintenance interval even in a harsh environment.

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

●WW Attached



●QZWW (QZRR)



Unit: mm

Model No.	*Dimensions including WW Overall length L	Dimensions including QZWW Length QWL	Outer diameter QWD	Overall length AL
SBK3636-5.6	134	38	69	210
SBK4040-5.6	146	40.4	79	226.8
SBK5050-5.6	175	45	89	265

*1 Full length dimensions with WW are normal full length and of the same size methods.

*2 Being accompanied is dimensions same as QZWW a QZ+ labyrinth seal.

⚠ 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. Contact 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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