



Caged-Ball High-Load Ball Screw

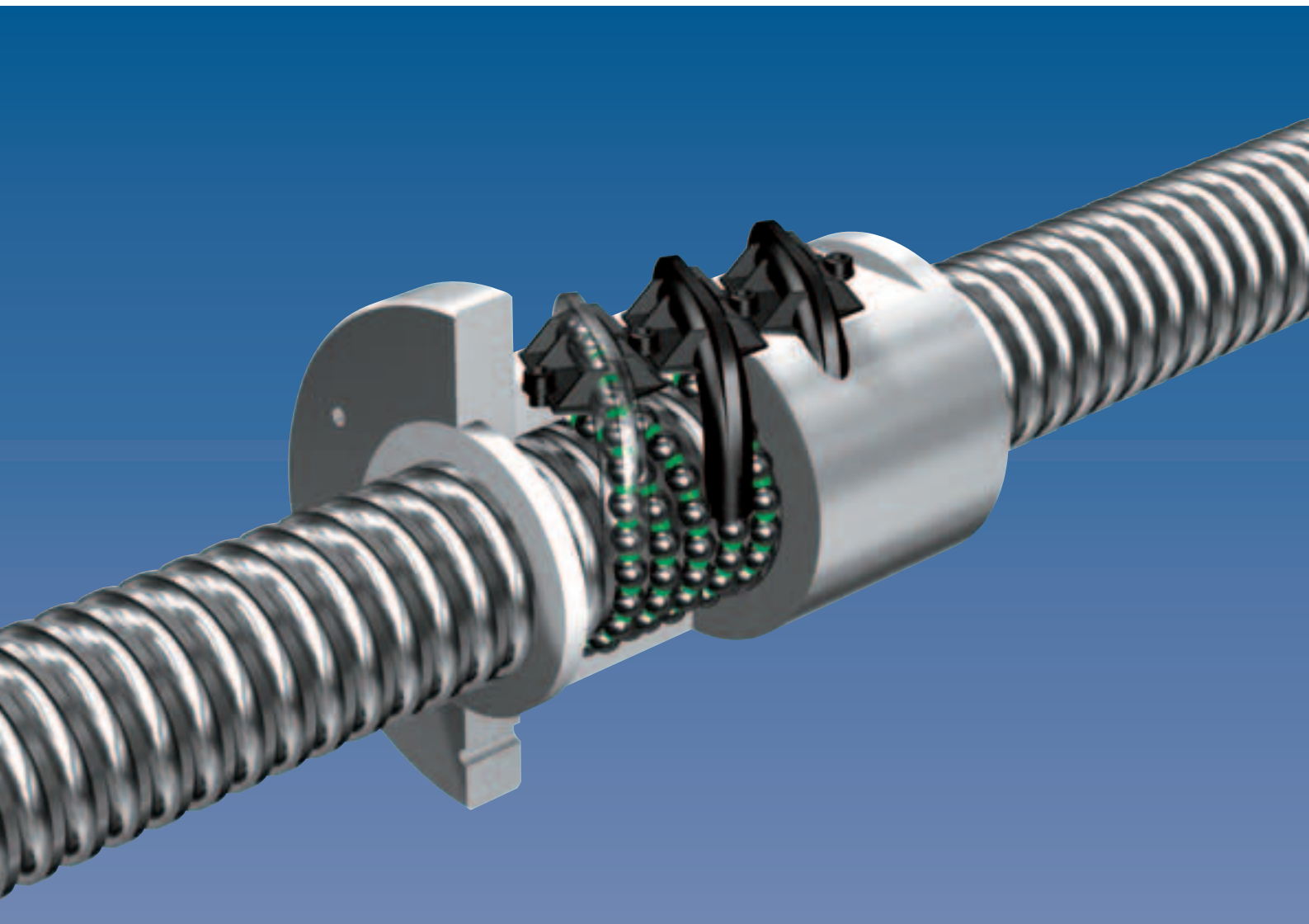
High load capacity

High speed

Low torque fluctuation

Low noise and long-term maintenance-free operation

HBN



Allows a machine used in high-load range to be motor driven
Caged-Ball High-Load Ball Screw

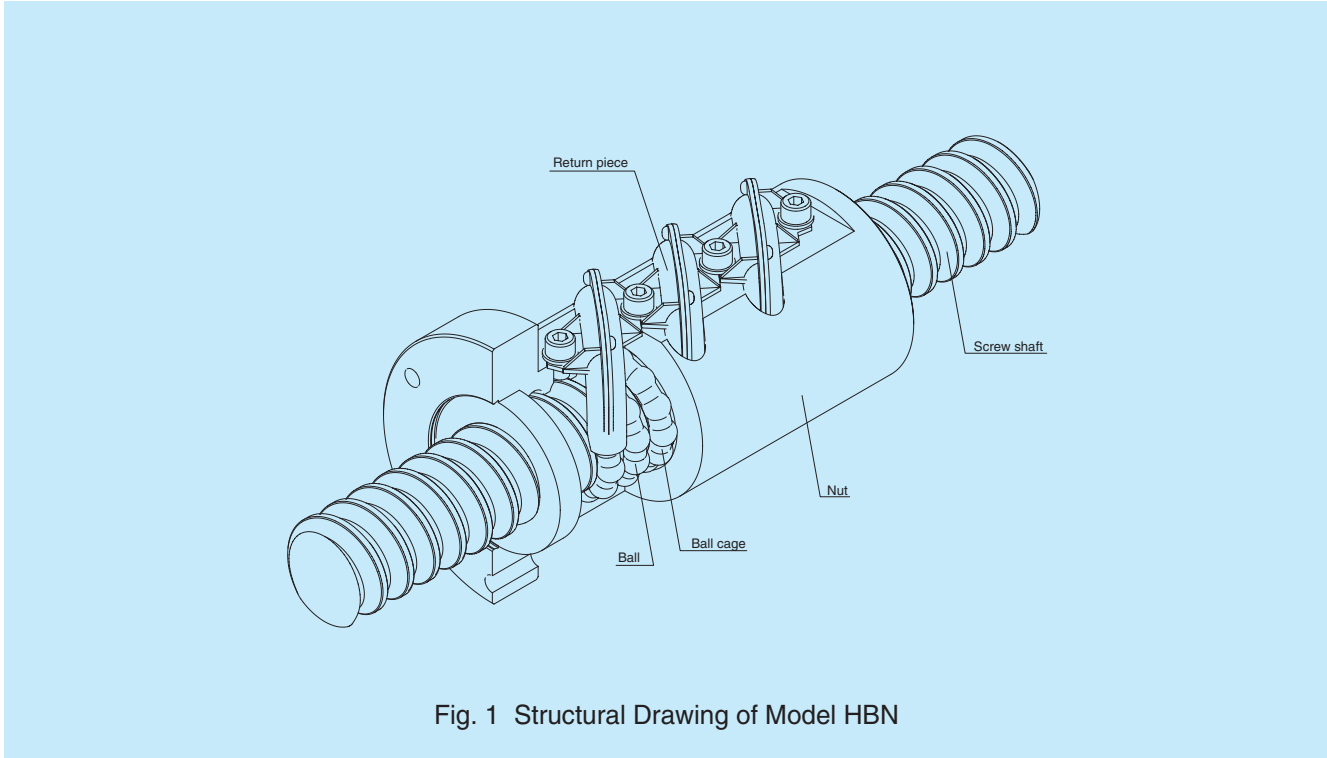


Fig. 1 Structural Drawing of Model HBN

Construction

Caged-Ball high-load ball screw model HBN is characterized by its internal structure design optimum for operation under high-load conditions and, thus, by a significantly enhanced load rating as compared with conventional ball screws.

Model HBN is provided with a ball cage that encases the balls to eliminate ball-to-ball collisions and friction and improve the retention of a lubricant. This allows a longer service life, lower noises, and lower torque fluctuation even under high-load conditions.

Model HBN supports a circulating mechanism with enhanced strength that allows the return piece to pick up balls in the near tangential direction. The circulating mechanism makes the use with DN value 130,000 possible.

Applications

- Injection molding machine
- Pressing machine
- Blow molding machine
- Extrusion molding machine
- Other machines

In particular,

you can use HBN efficiently instead of a hydraulic cylinder.

Model HBN is more excellent than the hydraulic cylinder in terms of:

1. energy saving (power consumption 1/5 to 1/3 times less than that of the hydraulic cylinder);
2. clean environment;
3. machine controllability;
4. maintainability; and
5. positioning accuracy.

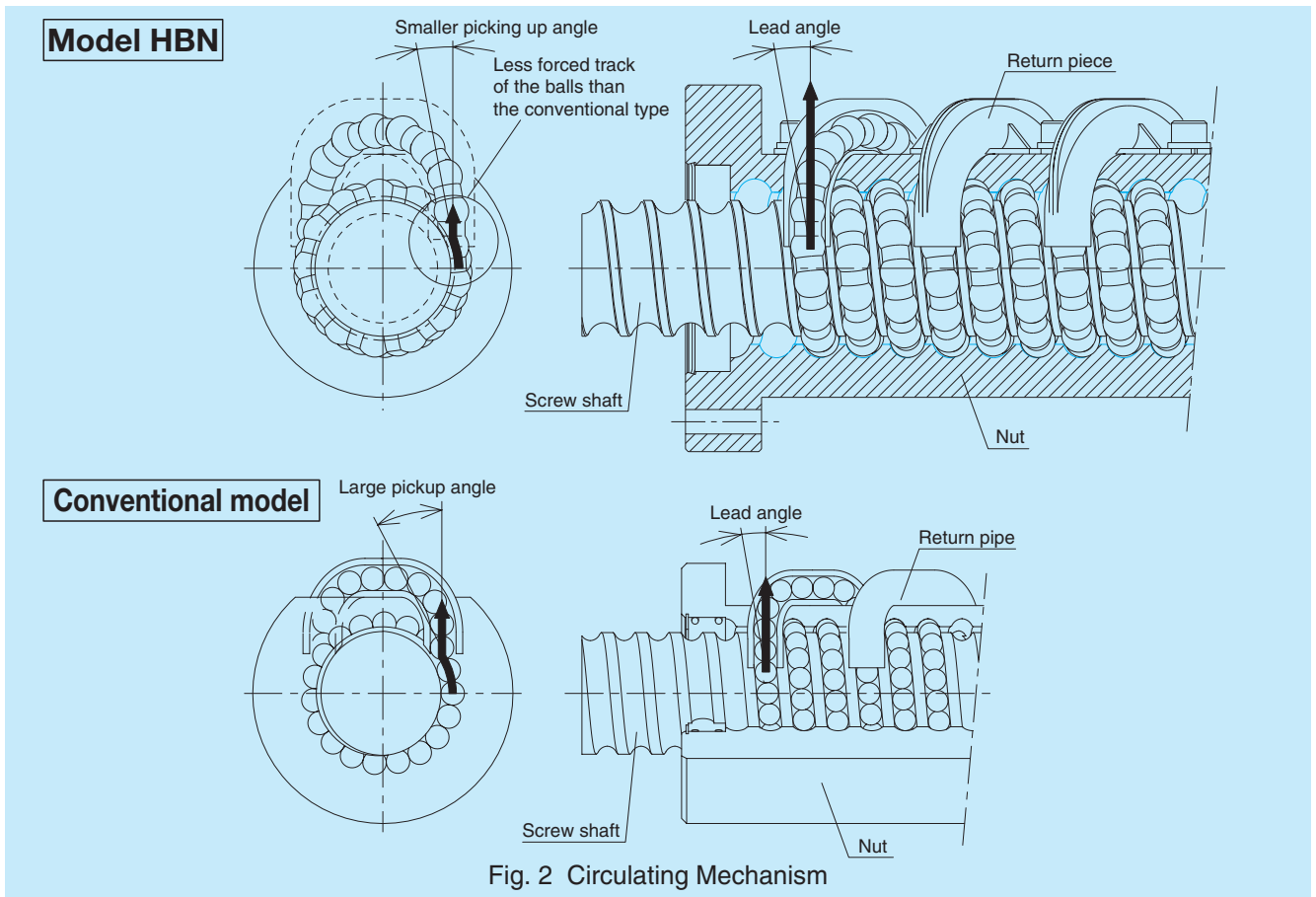
Features

High load

The HBN has the internal structure suitable for a high load. It takes full advantage of the ball cage, being resistant to the load rating load more than twice higher than that of the conventional product.

High speed

The return piece for the HBN is based on the circulating mechanism that picks up balls in the near tangential direction. The nearly ideal circulating mechanism allows balls to run unforcedly. It enables the use of the return piece and the ball cage designed to provide sufficient strength, under the DN value rated at 130,000.

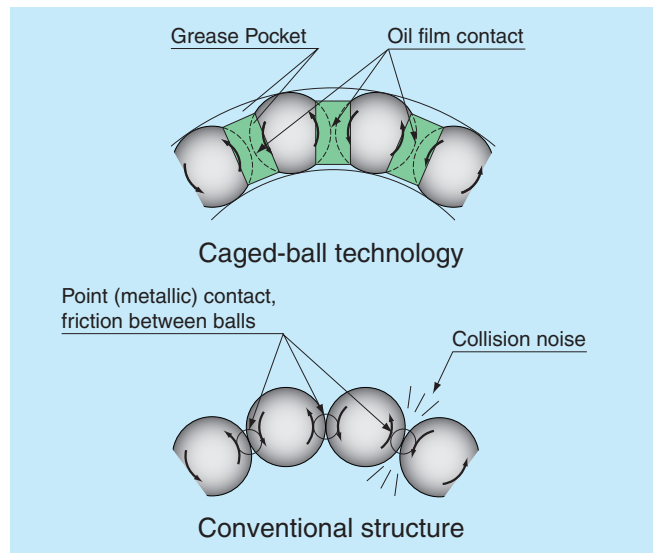


Smooth motion

The use of a ball cage eliminates ball-to-ball friction, offering higher durability, lower dynamic torque fluctuation, and smoother motion.

Low noise

The use of a ball cage eliminates collision noise. The return piece has no lips and picks up balls and is also capable of suppressing collision noise. It contributes to implementing operation under lower noises.

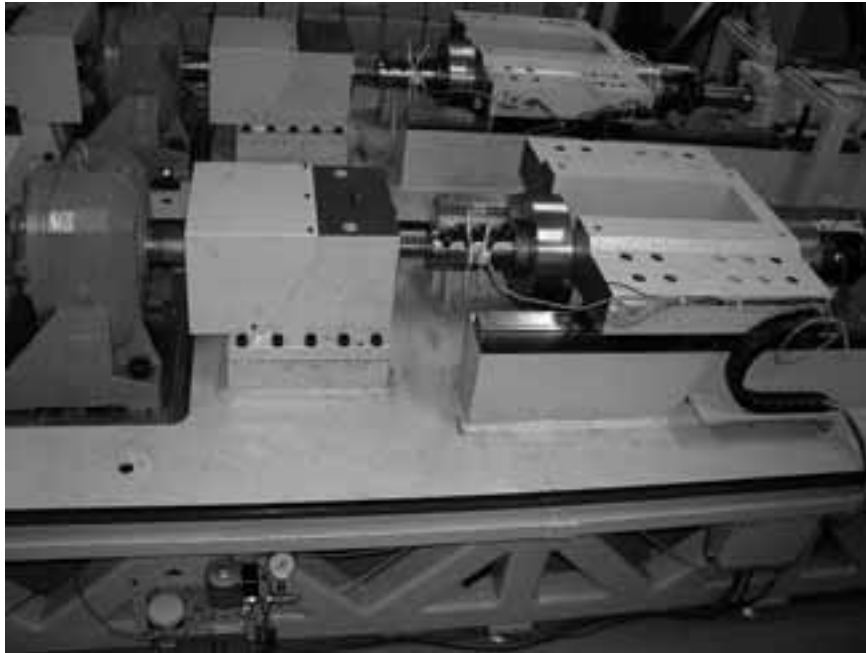


Performance

■Data of a load durability test for HBN

Load durability testing

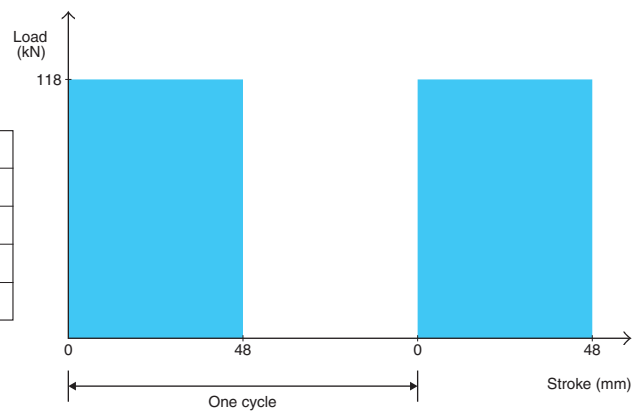
Test piece: HBN5016-7. 5RRG2+700LC7



Load durability tester

Data

Applied load	118kN
Stroke	48mm
Travel speed	Up to 3.8m/min
Shaft rotation speed	Up to 240min ⁻¹
Lubrication	Grease lubrication (LUBE LUBER MY-2)



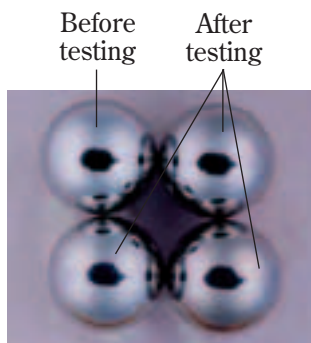
Loading pattern



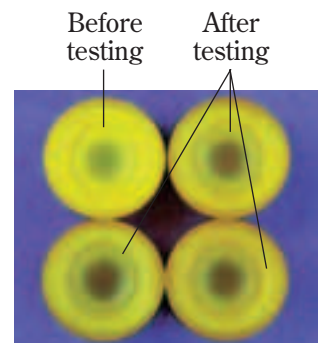
Ball screw nut



Ball screw shaft



Balls



Ball Cage

Result

The HBN has incurred no errors over 3 million cycles of running. (Still running)

■Data of a high-speed durability test for HBN

High-speed durability testing

Test piece: HBN5016-7. 5RRG2+1200LC7

Data

Stroke	480mm
Travel speed	Up to 40m/min
Acceleration	Up to 9.8m/s ²
Shaft rotation speed	Up to 2500min ⁻¹
Lubrication	Grease lubrication (LUBE LUBER MY-2)

Result

The HBN has incurred no errors over 2,000 km of running. (Still running)

■Data of smoothness evaluation

Torque measurement

Test piece: HBN5016-7. 5RRG2+1200LC7

Data

Stroke	200mm
Travel speed	0.96m/min
Shaft rotation speed	60min ⁻¹
Lubrication	Grease lubrication (LUBE LUBER MY-2)

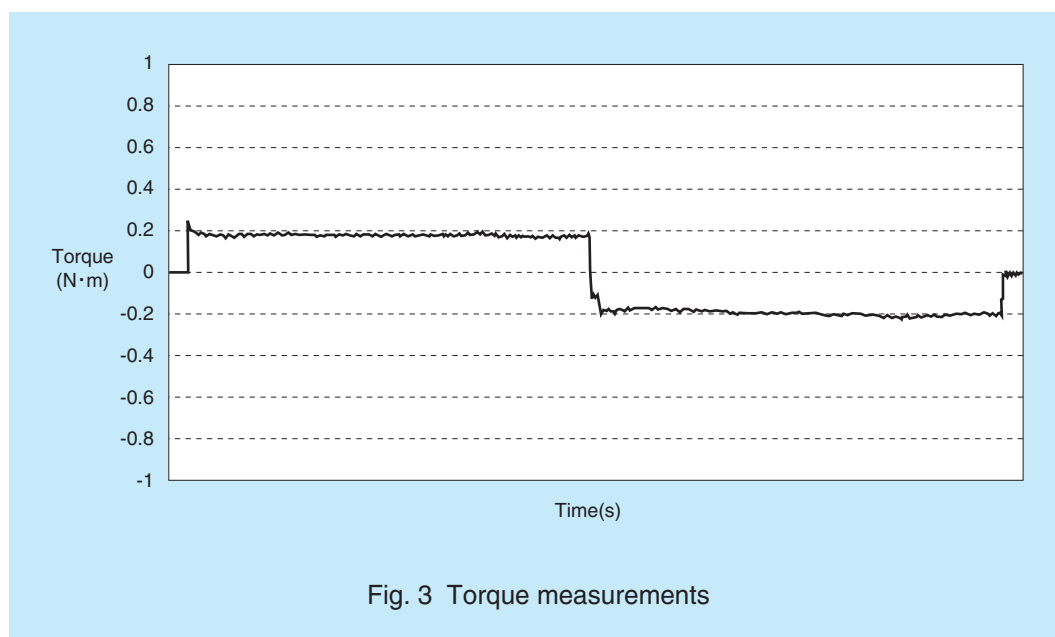


Fig. 3 Torque measurements

■Data of a noise test for HBN

Noise measurement

Test pieces: HBN3210-5RRG2+994LC7
: BNF3210-5RRG2+994LC7

Data

Stroke	600mm
Lubrication	Grease lubrication (LUBE LUBER MY-2)

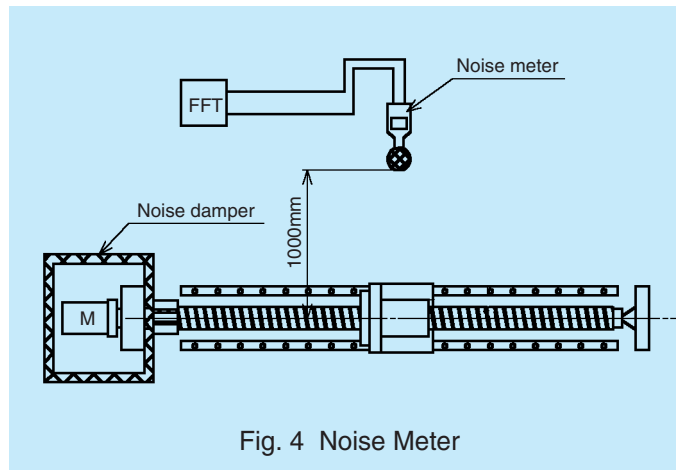


Fig. 4 Noise Meter

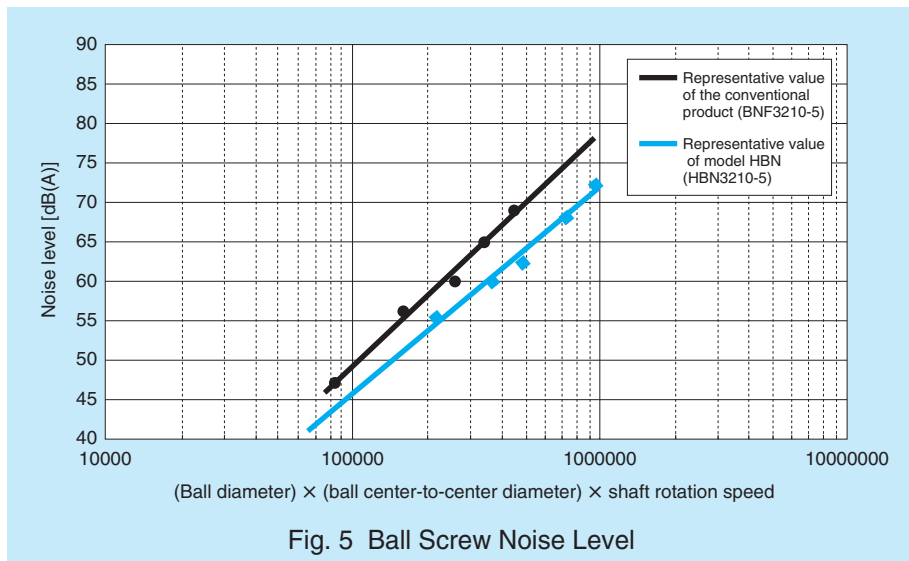


Fig. 5 Ball Screw Noise Level

Result

HBN produces 3 to 5 dBA less noise than the conventional product.

Load Rating and Nominal Life

Basic static load rating C_{0a} · Permissible load F_p

When a still or moving ball screw incurs an excessive load or a high shock load, local permanent deformation occurs between the raceway surface and the steel ball. The permanent deformation hinders smooth motion if its amount exceeds a limit.

As is generally known, the amount of permanent deformation 0.0001 or fewer times as large as the steel ball's diameter brings about no practical problems. The load corresponding to that amount is referred to as basic static load rating C_{0a} . However, in the case of the heavy load ball screw, it is designed in order to achieve longer a life than a conventional type under a high load, however, it is still necessary to take the permissible load F_p into consideration with regard to a thrust load. The permissible load F_p is the largest thrust load receivable, and the ball screw should be used within this range. When a largest thrust load acting on the ball screw undergoes change due to shock or other factors, safety must be taken into consideration as regards the permissible load F_p .

Basic dynamic load rating C_a

Basic dynamic load rating C_a is used to determine the service life of the ball screw that is moved with the nut loaded.

Basic dynamic load rating C_a refers to the axial load under which the nominal life of 90 percent of same ball screws moved individually becomes 10^6 rev.

Table 1 Load factor

Vibration or shock	Speed (V)	f_w
Fine	Fine speed $V \leq 0.25$ m/s	1.0~1.2
Low	Low speed $0.25 < V \leq 1.0$ m/s	1.2~1.5
Moderate	Moderate speed $1.0 < V \leq 2.0$ m/s	1.5~2.0
High	High speed $V > 2.0$ m/s	2.0~3.5

Nominal life

We can get the service life of the ball screw from the basic dynamic load rating and the axial load as follows.

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

L : Nominal life rev

C_a : Basic dynamic load rating N

F_a : Axial load N

f_w : Load factor (Table 1)

Service life period

If revolution life L is known under constant stroke length and reciprocation count, we can get the service life period from the following equation.

$$L_h = \frac{L \times \ell}{2 \times \ell_s \times n_1 \times 60}$$

L_h : Service life period hr

ℓ_s : Stroke length mm

n_1 : Reciprocation count per minute min^{-1}

ℓ : Lead mm

Accuracy Standard and Axial Clearance

Accuracy standard

The THK high-load ball screw is manufactured according to JIS B 1192 (precision ball screw) in terms of accuracy. The lead accuracy is measured using a reliable laser instrument for assurance. For details about the standard value, see our general catalog.

Axial clearance

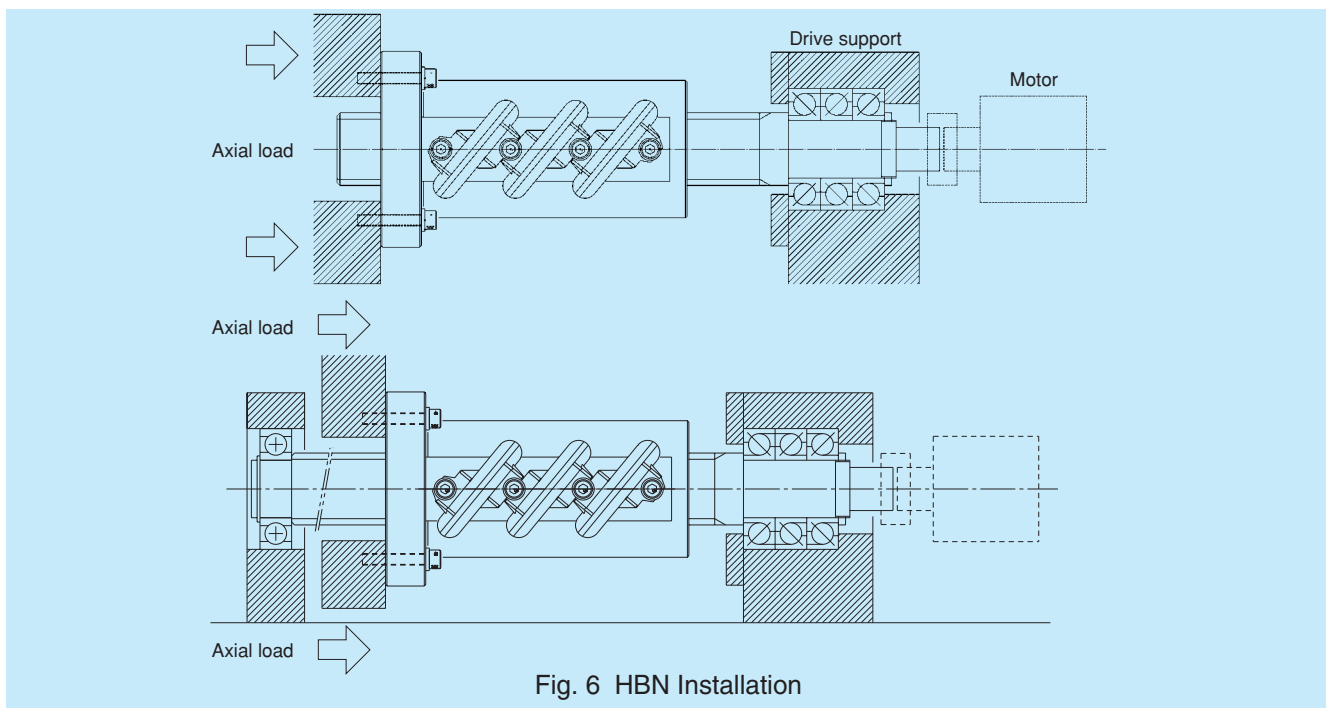
The THK high-load ball screw is accompanied by the standard G2 axial clearance. Ball screws with other clearance are also available if you need them. (See the Table below.) The ball screw with the GT or G1 clearance under C7 may have a partially negative clearance.

Table 2 Axial Clearance

Clearance symbol	GT	G1	G2	G3
Axial clearance	0~0.005	0~0.01	0~0.02	0~0.05

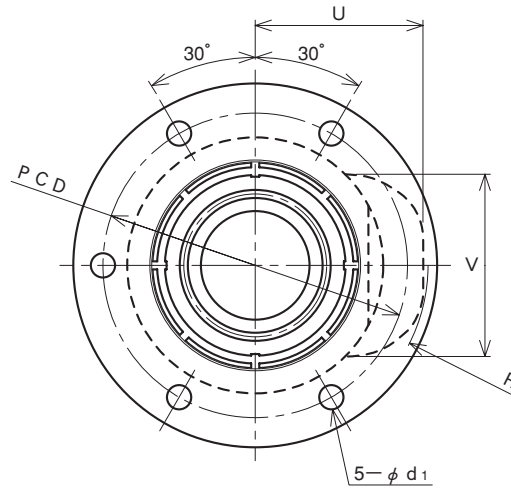
High-Load Ball Screw Installation

Generally, the axial load applied to the ball screw is absorbed by a flange surface. We recommend using the following approach to installation. If the bolt is subject to a tensile load depending on the installation condition, you should fully consider the bolt strength.



MEMO

HBN's Dimensions



Model No.	Screw shaft outer diameter d	Lead R	Ball center diameter dp	Thread minor diameter dc	Number of loaded circuits Rows × turns	Basic load rating		Permissible load* Fp kN
						Ca kN	Coa kN	
HBN 3210-5	32	10	34.0	26.0	2×2.5	102.9	191.3	31.9
HBN 3610-5	36	10	38.0	30.0	2×2.5	108.2	220.4	33.5
HBN 4010-7.5	40	10	42.0	34.0	3×2.5	162.6	366.0	50.4
HBN 5010-7.5	50	10	52.0	44.0	3×2.5	179.1	462.7	55.5
HBN 3612-5	36	12	38.4	29.0	2×2.5	141.1	267.7	43.7
HBN 4012-7.5	40	12	42.4	33.0	3×2.5	212.4	441.6	65.8
HBN 5012-7.5	50	12	52.4	43.0	3×2.5	235.7	572.2	73.1
HBN 5016-7.5	50	16	53.0	39.6	3×2.5	379.6	820.9	117.7
HBN 6316-7.5	63	16	66.0	52.6	3×2.5	427.1	1043.8	132.4
HBN 6316-10.5	63	16	66.0	52.6	3×3.5	577.1	1461.3	178.9
HBN 6320-7.5	63	20	66.5	49.6	3×2.5	578.8	1283.1	179.4

Note: Permissible load Fp* indicates the maximum load in the axial direction that the corresponding Ball Screw model can receive. All HBN models are designed to achieve long service life under higher loads than the conventional ball screw models.

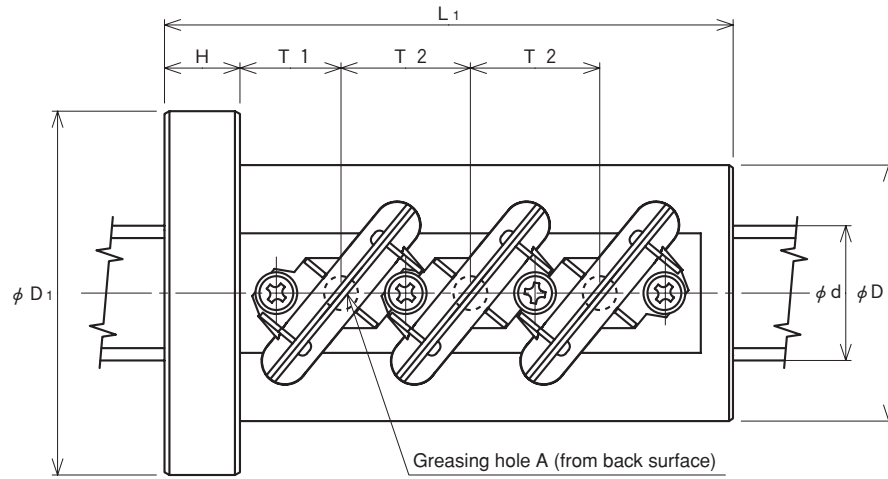
■ Example of model number coding

HBN3210-5 RR G2 +1200L C7

1
2
3
4
5

1 Model number **2** Seal symbol (RR: labyrinth seals on both ends)

3 Symbol for clearance in the axial direction **4** Overall screw shaft length (mm) **5** Accuracy symbol



Unit:mm

Rigidity K N/ μ m	Nut dimensions											
	Outer diameter D	Flange diameter D ₁	Overall length L ₁	H	PCD	d _i	T1	T2	U _{MAX}	V _{MAX}	R _{MAX}	Greasing hole A
1077	58	85	98	15	71	6.6	22	30	42	46	43.5	M6
1176	62	89	98	15	75	6.6	22	30	44	50	46	M6
1910	66	100	135	18	82	9	23.5	30	45.5	54	48	M6
2279	78	112	135	18	94	9	23.5	30	51	63.5	54.5	M6
1207	66	100	116	18	82	9	26	36	48	52.5	50	M6
1922	70	104	152	18	86	9	26	36	50	56	52	M6
2345	80	114	152	18	96	9	26	36	55	66	58.5	M6
2392	95	135	211	28	113	9	37.5	48	63.4	69.6	65.2	PT-1/8
2898	105	139	211	28	122	9	37.5	48	69.5	82	72.5	PT-1/8
4029	105	139	259	28	122	9	53.5	64	69.5	82	73	PT-1/8
3030	117	157	252	32	137	11	44	60	78	86.5	80	PT-1/8

Note

Each rigidity value in the table represent the spring constant obtained from the load and the elastic displacement when a load in the axial direction that is 30% of the basic dynamic load rating (Ca) is applied.

Since this value does not include rigidity of parts related to the ball screw nut mounting section, the actual rigidity may be approx. 80% of this value. If the load in the axial direction (Fa) is not equal to 0.3 Ca, the rigidity value (KN) can be obtained in the following equation.

$$K_N = K \left(\frac{F_a}{0.3 C_a} \right)^{\frac{1}{3}}$$

K: Rigidity value in the table

THK Caged-Ball High-Load Ball Screw HBN

Precautions on use

- **Permissible rpm**
 - Under high rpm, the high-load ball screw may resonate with the characteristic frequency of the ball screw shaft, being unable to function. You must use the ball screw below the resonance point (hazardous speed). (For details, see our general catalog.) In addition, the ball screw is restricted by the DN value (product of rpm and center ball diameter) independently of the installation approach. Note the two points. (HBN's permissible DN value: 130,000)
- **Notes on handling**
 - The ball screw is a precision product. Should you drop or strike the ball screw, it may be damaged or its function may be changed. If the nut is taken off the screw shaft (ball screw section), the ball and the cage come off. You should use particular care for handling.
- **Installation**
 - If you force a part against the screw shaft or the nut, the revolving surface may be impressed. When installing a part, take care not to apply unnecessary force to the screw shaft and the nut.
 - If the screw shaft support does not correspond to the nut, the service life may be extremely shortened. You should, therefore, take particular care for installed part accuracy and installation accuracy.
- **Coolant**
 - If you use HBN in an environment where coolant or the like penetrates the nut, the product function may be damaged depending on its type. Contact THK.
- **Temperature range during operation**
 - You should not use HBN at a temperature of 80 or more degrees C because it is made of special resin.
- **Lubrication**
 - The high-load ball screw requires lubrication.
 - If you use the ball screw under a high load, we recommend LUBE LUBER MY-2 grease as the standard.
 - Except for a special case, the ball screw contains grease which can be used as is. After commissioning at your site, you should grease the ball screw to be used again.
 - If you use the ball screw in an environment always subject to vibration, in a clean room, in a vacuum chamber, or in other special environments at low or high temperature, the regular grease may be inapplicable. In such a case, please feel free to contact THK.

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