Ball Screw Support Angular Contact Thrust Ball Bearing Unit "BSTU Series"

1. Introduction

NTN has been marketing ball screw support bearings—the ULTAGE Series “ball screw support single row angular contact thrust ball bearing unit (BST series)” products.

Recently, NTN has developed and commercialized a novel high load rating double row angular contact ball bearing unit and has added it to the ULTAGE series line of products.

Our single row BST series products are typically used in Asian markets: while our newly developed BSTU series of products, standard ball screw support angular contact thrust ball bearing products, are intended for the European market.

Our newly developed BSTU series high capacity double row angular contact ball bearings unit products boast a higher load bearing capacity—highest among ball screw support bearings in the world. At the same time, adoption of a novel seal helps realize lower running torque and positive dust-proofing performance.

NTN has named this new series “BSTU (Ball screw Support angular contact Thrust ball bearing Unit) series”.

2. Structure and advantages

Fig. 1 shows the structure of a BSTU series product.

The advantages of the BSTU series bearings are hereunder described.

2.1 Realization of higher load capacity

Through its unique design featuring the maximum possible number of larger steel balls, NTN has realized greater load capacity, as shown in Figs. 2 and 3. These load capacity values are highest among the world’s ball screw support bearings.
2.2 Low torque and reliable dust-proofing performance

By adopting a novel seal lip shape shown in Fig. 4 (light contact seal), we have achieved both reliable dust-proofing performance and lower running torque of the bearing.

A unique light-contact type main lip helps realize reliable dust-proofing performance and lower running torque of the bearing: the side lip positively prevents the grease in the bearing from flowing out.

This pre-greased bearing is an easy-to-handle, eco-friendly design—the user does not need to rinse and degrease the bearing and prefill grease into the bearing when assembling the bearing at the user’s site.

2.3 Longer life

Any ball screw support bearing is subjected to vibration during rapid traverse (the cutting tool approaches the work piece) and low speed rotation in machining, as well as during cutting operation. Therefore, the bearing has to satisfy very demanding requirements for its lubrication. To prevent possible disruption of oil film caused by vibration and shock, we have adopted urea-based grease as standard because of its excellent fretting resistance quality and grease life.

The performance of NTN’s standard urea-based grease “L588” will be described later in Sec. 3.

2.4 Improved mountability

As shown in Figs. 5 and 6, the outer ring is provided with mounting bolt holes so that the bearing is easily mounted to the housing.
2.5 Adoption as new standard series
The BSTU line of products feature bore diameter of 20 to 100 mm, and outside diameter of 68 to 200 mm.

The bearing designation system of this new series is described to the right.

3. Assessment of performance

The results of performance test on the BSTU series bearings are described below.

3.1 Temperature characteristics
The test bearings were run, simulating typical run patterns for machine tool bearings. Consequently, as shown in Fig. 7, the NTN’s BSTU series bearings boast excellent temperature characteristics (limited temperature rise) thanks to adoption of the "new light-contact type seal". We believe that owing to positively limited temperature rise, the BSTU series bearings least contribute to thermal elongation of the ball screw, and is capable of high-speed operation on machine tools.

**<Test conditions for temperature rise test>**
Bearing number: BSTU3080LLX/GNP4U/L588
Running speed: 1,000–5,000 min⁻¹
Preload: 2,700 N
Lubrication system: Grease lubrication
(Amount of prefill: 1.6 gr, 25% the bearing space)

3.2 Torque characteristics
Fig. 8 provides information about running torque occurring on the test bearings running in one direction only. Regardless of running speed, the BSTU test bearings boast stably low running torque.

**<Test conditions for torque characteristics test>**
Bearing number: BSTU3080LLX/GNP4U/L588
Preload: 2,700 N
Lubrication system: Grease lubrication
(Amount of prefill: 1.6 gr, 25% the bearing space)
3.3 Limiting speed

Because of limited temperature rise and stably low torque, the BSTU bearings are capable of operation at higher speed range (Fig. 9).

Bearing number: BSTU3080LLX/GNP4U/L588
Lubrication system: Grease lubrication
(Amount of prefill: 1.6 gr, 25% the bearing space)

3.4 Grease characteristics

The BSTU bearings adopt urea-based grease “L588” that boasts excellent fretting resistance quality and grease life. Fig. 11 shows the results of fretting corrosion test. In this test, a stationary ball is forced to a plate as shown in Fig. 10, and the plate is horizontally reciprocated to develop reciprocating friction, thereby the characteristics of the grease are evaluated based on the depth of resultant wear.

Compared with lithium grease, the NTN’s standard urea-based grease “L588” boasts excellent fretting corrosion resistance quality, and is suitable for ball screw support bearings that are subjected to inching motion and oscillating motion.

<Test conditions for fretting corrosion test>
Load: 98 N
Max. contact pressure: 2,560 MPa
Number of load applications: 8.6 \times 10^6 cycles
Test duration: 8 h
Sliding cycles: 30 Hz, amplitude: 0.47 mm
Ambient conditions: Room temperature, atmosphere

3.5 Dust-proofing characteristics

On machine tools, chips and coolant can reach an area around the ball screw. Therefore, the ball screw support bearing needs to be resistant against ingress of dust.

Fig. 12 exhibits the result of dust-proofing test on our newly developed ball screw support bearing. Thanks to excellent dust-proofing feature of the novel light-contact type seal, there is no ingress of foreign matters into the bearing.

<Test conditions for dust-proofing test>
Bearing number: BSTU3080LLX/GNP4U/L588
Running speed: 2,200 min\(^{-1}\)
Lubrication system: Lubrication with prefilled grease
Dust: Grain size 5 to 75 \(\mu\)m
(Ingredients: \(\text{SiO}_2\), \(\text{Fe}_2\text{O}_3\), \(\text{Al}_2\text{O}_3\), etc.)
Hue of dust: Brown
Test duration: 1 hr.
4. Conclusion

NTN’s newly commercialized ball screw support bearing “BSTU series” products boast higher load capacity and lower torque, which mark the world’s best performance levels, as well as improved dust-proofing quality, longer life and easier mounting procedure. To be able to help realize the eco-friendly society, bearing manufactures have to realize engineering innovations to satisfy various requirements on various areas in machine tools. In this context, our BSTU products provide solutions to needs for longer bearing life and lower energy consumption.

To be able to cope with various market needs, NTN will remain committed to development efforts for next-generation bearings through continued improvements and challenges for higher functionality.