

B-1 Selection Guide to NSK Ball Screw

B-1-1 Features of NSK Ball Screws

① Quick delivery

Standard ball screws are in stock for short lead time.

- Precision ball screws with finished shaft end
PSS Type, MA Type, FA Type, SA Type, KA Type
- Precision ball screws with blank shaft end
MS Type, FS Type, SS Type

Ball screws for transfer equipment are also available in stock.

- Finished shaft end
VFA Type, RMA Type
- Blank shaft end
RMS Type, R Series

② Competitive prices

NSK reduces cost by well-planned mass production of standardized items. We rank the best in the world production of ordered items. We are able to offer our products at competitive prices by producing similar items in the same production group.

③ Unparalleled accuracy

NSK utilizes its unique grinding technique and measuring equipment for topnotch precision.

④ Superb durability

NSK uses thoroughly purified alloy steel for superb durability.

⑤ No backlash, and unparalleled rigidity

NSK ball screws use Gothic arch grooves as shown in Fig. 1.1. The Gothic arch has no clearance between the balls and grooves with applying preload, and no backlash can be obtained. As providing controlled rigidity is easy, appropriate rigidity is obtained.

As the Gothic arch also minimizes the clearance between the balls and the grooves, the backlash is minimized without applying preload.

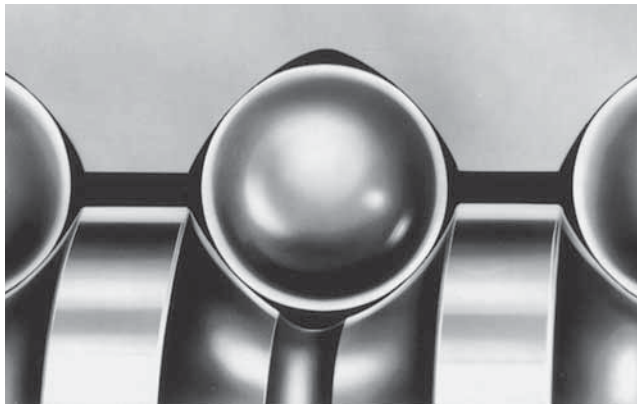


Fig. 1.1 Ball groove profile of NSK ball screw

⑥ Smooth movement assures high efficiency

NSK uses the Gothic arc design for the ball grooves. This design prevents the balls from slightly wedging into the groove of the ball nut and screw shaft and causing minute vibration. This phenomenon is common with the circular-arc design used by other manufacturers. The Gothic arc, along with the low friction inherent in a ball screw, results in a smooth and highly efficient conversion of motion as shown in Fig. 1.2.

⑦ Optimal units available

Utilizing bearing technology, NSK produces high quality support units (for light load type to be used for small equipment and heavy load type to be used for machine tools) which are exclusive for ball screws. These units are standardized and always in stock.

NSK also offers quality-assured accessories such as lock nuts to tighten bearings, travel stoppers to prevent overrun, and sealing units to cool hollow shaft ball screws.

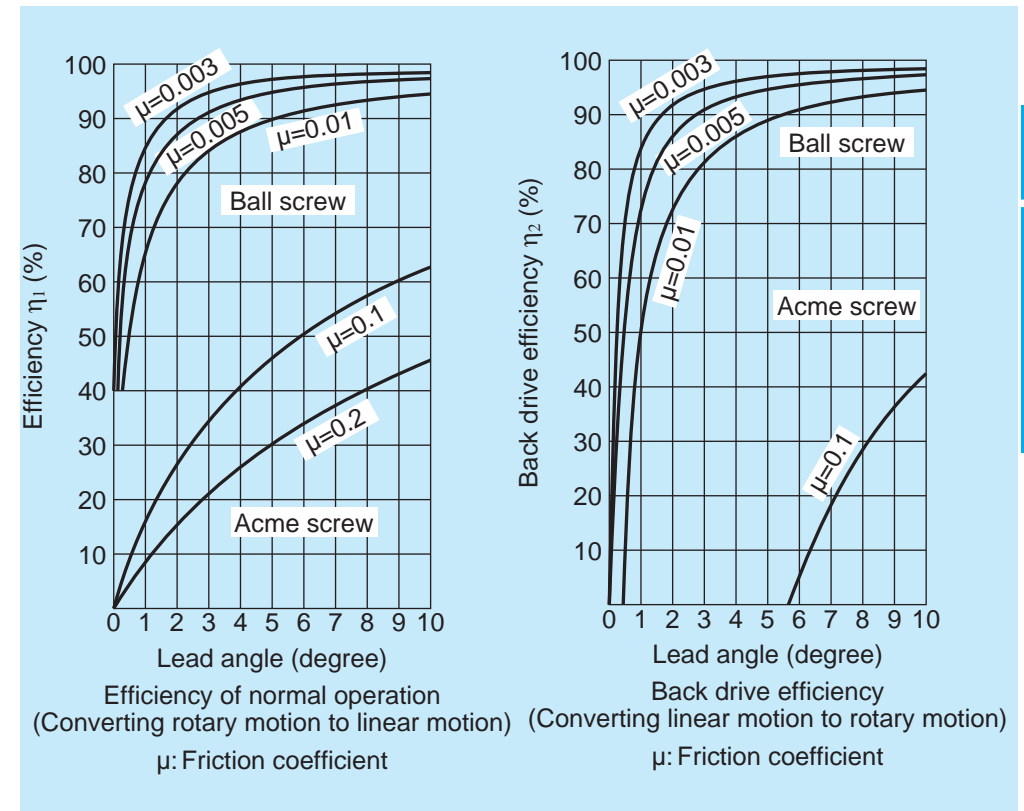


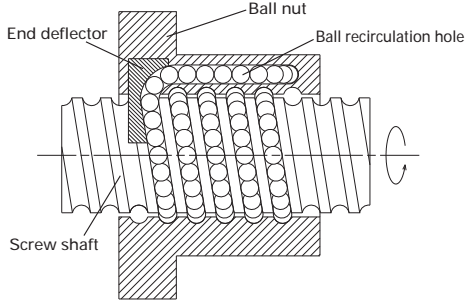
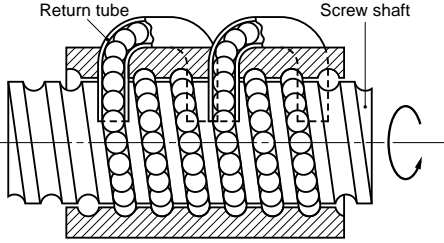
Fig. 1.2 Mechanical efficiency of ball screws

B-1-2 Structure of a Ball Screw

Balls are placed between the screw shaft and nut, and roll. This system is called a "ball screw." To keep the balls recirculating continually, this system requires a screw shaft, a nut, balls, and recirculation components as basic items. A ball screw has the following functions.

- ① Converting motion: Changing rotary motion to linear motion (normal operation); Changing linear motion to rotary motion efficiently (back-drive operation).
- ② Increasing power: A small torque is converted to a large thrust force.
- ③ Positioning: Sets accurate position in linear motion.

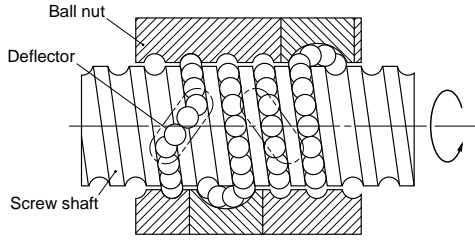
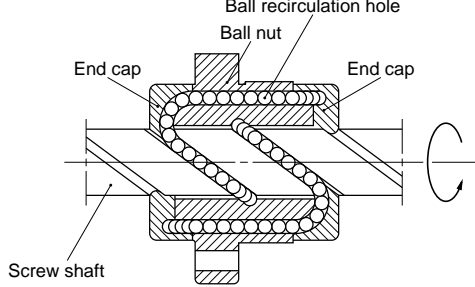
Table 2.1 Ball screw recirculation system

End deflector type	Ball return tube type
 <p>[Structure] Balls are smoothly picked up in tangential direction at the end of nut, and recirculated via hole in the nut. If the ball is picked up at the middle of the nut, it is called middle deflector type.</p> <p>[Features] · Small nut O.D., allows compact design. · Low noise, High speed.</p>	 <p>[Structure] Balls are recirculated through pipe of optimized size, bridging the start and end of recirculation.</p> <p>[Features] · Adapt to various specifications. (screw shaft diameter, lead)</p>

B-1-2.1 Ball Recirculation System

A ball recirculation system is categorically most important, as well as the preload system, to classify the structure of ball screw.

As shown in Table 2.1, four types of ball recirculation system are used for NSK ball screw.

Deflector type	End cap type
 <p>[Structure] Balls are recirculated by horseshoe shaped deflector bridging the pitch groove.</p> <p>[Features] · Suitable for fine lead ball screws. · Small nut O.D., allows compact design.</p>	 <p>[Structure] Balls are picked up by cap placed at both ends of the nut, and recirculated via hole in the nut.</p> <p>[Features] · Suitable for large lead ball screws. · Not universal due to complex recirculation structure.</p>

B-1-2.2 Preload system

There are four systems to apply preload to NSK ball screws depending on the application.

Table 2.2 Preload system for ball screw

Preload system	Double nut preload (D Preload)	Offset preload (Z Preload)
Structure		
Description	<p>Uses two nuts, and inserts a spacer between them to apply preload. In general, a spacer is thicker (by the deformation equivalent to the preload) than the actual space between two nuts. On the contrary, a thin spacer is inserted in some cases.</p>	<p>To apply preload, the lead near the center of the nut is enlarged by the volume equivalent to preload (α). Uses a single nut to create a preload similar to D preload. Not using spacer enables compact nut design.</p>
Nut length	Long	Medium
Torque characteristics	Fair	Fair
Rigidity	Excellent	Excellent

Preload system	Oversize ball preload (P Preload)	Spring preloaded double nut (J Preload)
Structure		
Description	<p>Balls slightly larger than the space of the ball groove (over-size balls) are inserted to apply preload by balls' four-point contact. Provide better torque characteristics in the low torque range.</p>	<p>A spring is used as a spacer of D Preload. Must be used with discretion in its varied rigidity by load direction.</p>
Nut length	Short	Long
Torque characteristics	Fair	Excellent
Rigidity	Fair	Poor