

LINEAR MOTION

Precision Ballscrews

Permissible Rotational Speed

Dangerous screw shaft speed

At high rotational speeds, the ballscrew causes resonance due to the characteristic frequency of the screw shaft, which may make operation impossible. The shaft speed should therefore be set at a level below the resonant point (critical speed).

Figure 1 indicates the relationship between screw-shaft diameter and critical speed.

Permissible rotational speed based on the critical speed can be calculated using equation (8), wherein 0.8 is used as a safety factor.

$$N_1 = \frac{60 \cdot \lambda_{12}}{2\pi \cdot \sqrt{I/b^2}} \times \sqrt{\frac{E \cdot 10^3 \cdot I}{\lambda \cdot A}} \times 0.8 = \lambda_2 \cdot \frac{d_1}{I/b^2} \cdot 10^7$$

where

- N1 : permissible rotational speed determined based on the critical speed (min⁻¹)
- /b : distance between mounting positions (mm)
- E : Young's modulus (2.06 x 10⁵ N/mm²)
- I : minimum geometrical moment of inertia of the screw-shaft cross section (mm⁴)
- $I = \frac{\pi}{64} \cdot d_1^4$ d₁: Screw-shaft thread min diameter (mm)
- γ : density (specific gravity) (7.85 x 10⁻⁶ kg/mm³)
- A : screw-shaft cross-sectional area (mm²)
- $A = \frac{\pi}{4} \cdot d_1^2$

λ₁ and λ₂ = coefficient depending on the mounting method

Fixed/free:	λ ₁ = 1.875	λ ₂ = 3.4
Supported/supported:	λ ₁ = 3.142	λ ₂ = 9.7
Fixed/supported:	λ ₁ = 3.927	λ ₂ = 15.1
Fixed/fixed:	λ ₁ = 4.730	λ ₂ = 21.9

DN Value

The permissible rotational speed of the ballscrew should be determined based on the critical speed and DN value.

The permissible rotational speed determined based on the DN value can be calculated using equations (1) through (3).

Precision-Ground Ballscrew

$$N_2 = \frac{100\,000}{D} \dots\dots\dots (1)$$

(For BNF, BNFN and BIF 70.000)

where

- N₂ : permissible rotational speed determined based on the DN value (min⁻¹)
- D : ball center-to-center diameter (presented in the dimension table) (mm)

Rolled Ballscrew (excluding the large-lead type)

$$N_2 = \frac{50\,000}{D} \dots\dots\dots (2)$$

Large-Lead Rolled Ballscrew (BLK)

$$N_2 = \frac{70\,000}{D} \dots\dots\dots (3)$$

N₁ or N₂, whichever is lower, is taken as the permissible rotational speed.

For operating rotational speeds greater than N₂, high-speed ballscrew models are available. If you require these models, please contact our technical department.

Permissible Rotational Speed Diagram

