

B-II-12 Noise and Vibration

B-II-12.1 Consideration to Lowering Noise

As the machine operates at higher speeds, noise levels tend to increase. Covering the nut section is insufficient to lower noise. NSK has abundant data (NSK Motion & Control Technical Journal No.4, etc.), and offers advice to users regarding selecting ball screw.

To lower noise level in general, the following points should be taken into consideration.

① If the travel speed is the same, use as a large lead as possible to reduce rotational speed.

② Use a ball screw with smaller outer diameter as possible.

It often requires designing for critical dimensions, mandating special specification. Please consult NSK. For reference, noise levels by ball screws alone are plotted below. Formula for calculation is also shown below.

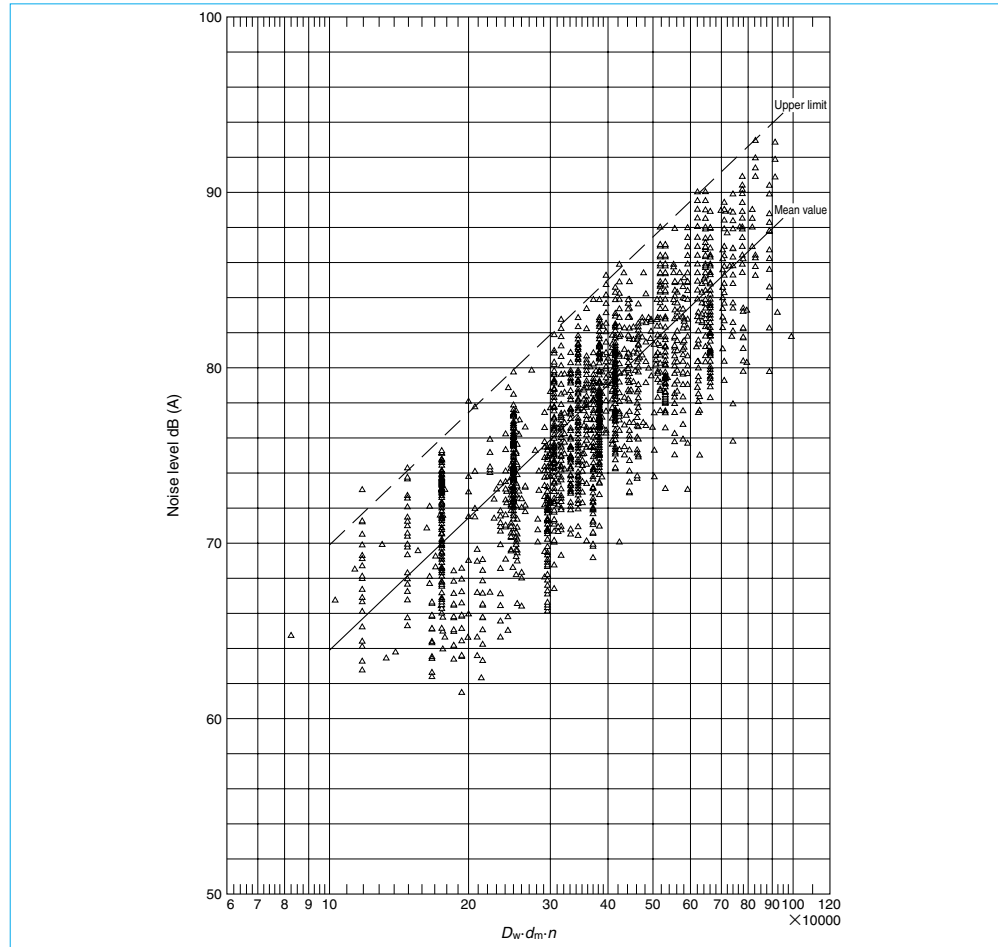


Fig. II-12-1 Noise levels of ball screws

Average value at measuring distance of 400 mm.....dB(A)=25.2 {log₁₀(D_w · d_m · n × 10⁻⁵)} + 63.9..... (II-33)

Upper limit.....Average value + 6dB(A)

D_w: Ball diameter (mm)

d_m: Ball pitch circle dia. (mm)

n: Rotational speed (min⁻¹)

If measuring distance is 1 m, the average noise level is: Various noise levels minus 8dB(A).

Example of calculation

* Use conditions

Nut model: DFT4010-5

From the dimension table: D_w=6.350

d_m=41

Maximum rotational speed: 2000 min⁻¹

* Calculation

By Formula II-33:

$$\text{dB(A)} = 25.2 \{ \log_{10}(D_w \cdot d_m \cdot n \times 10^{-5}) \} + 63.9 = 25.2 \{ \log_{10}(6.350 \times 41 \times 2000 \times 10^{-5}) \} + 63.9 = 82 \text{dB(A)}$$

* Result

The average value of noise level by ball screws alone at maximum rotational speed (measuring distance 400 mm) is 82dB(A). Upper limit is: 82dB(A) + 6dB(A) = 88dB(A)

* If the measuring distance is 1 m, the average value is 74dB(A), and upper limit is 80dB(A).

When installed, the noise of ball screw becomes higher by the noise of the machine and characteristics of machine vibration.

B-II-12.2 Consideration to Ball Screw Support System

Ball screw has low radial rigidity because its support span is longer compare to its shaft diameter. It has only small damping capacity, requiring as much support rigidity as possible through design. Simplify support bearing system to cut costs invites noise and vibration problems. The necessity to support both shaft ends is increasingly becoming important as the machine is operated at higher

speeds.

If one shaft end must be left unfixed without support bearing due to structural reasons, noise and vibration problems may occur. These problems are related to the natural vibration frequency of the screw shaft on the unsecured end. This problem can be averted by installing an impact damper to the shaft end (Fig. II-12*2). Please consult NSK.

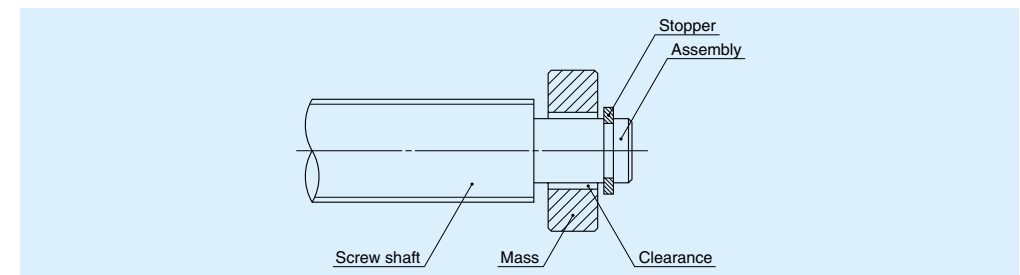


Fig. II-12-2 Impact damper (NSK patent)