Permissible Axial Load

Buckling Load on the Screw Shaft

With the ball screw, it is necessary to select a screw shaft so that it will not buckle when the maximum compressive load is applied in the axial direction.

Fig. 5 on B15-39 shows the relationship between the screw shaft diameter and a buckling load. The buckling load can be calculated by equation (5) below. Note that in this equation, the result is multiplied by a safety factor of 0.5.

$$P_1 = \frac{\eta_1 \cdot \pi^2 \cdot E \cdot I}{\ell_a^2} 0.5 = \eta_2 \frac{d_1^4}{\ell_a^2} 10^4 \quad \cdots\cdots\cdots (5)$$

P_1 : Buckling load (N)

ℓ_a : Distance between two mounting surfaces (mm)

E : Young's modulus (2.06×10^5 N/mm^2)

I : Minimum geometric moment of inertia of the shaft (mm^4)

$I = \frac{\pi}{64} d_1^4$ d_1: Screw-shaft thread minor diameter (mm)

η_1, η_2 = Factor according to the mounting method

Fixed - free	$\eta_1 = 0.25$	$\eta_2 = 1.3$
Fixed - supported	$\eta_1 = 2$	$\eta_2 = 10$
Fixed - fixed	$\eta_1 = 4$	$\eta_2 = 20$

Permissible Tensile Compressive Load on the Screw Shaft

If an axial load is applied to the ball screw, it is necessary to take into account not only the buckling load but also the permissible tensile compressive load in relation to the yielding stress on the screw shaft.

The permissible tensile compressive load is obtained from equation (6).

$$P_2 = \sigma \frac{\pi}{4} d_1^2 = 116 d_1^2 \quad \cdots\cdots\cdots (6)$$

P_2 : Permissible tensile compressive load (N)

σ : Permissible tensile compressive stress (147 MPa)

d_1 : Screw-shaft thread minor diameter (mm)

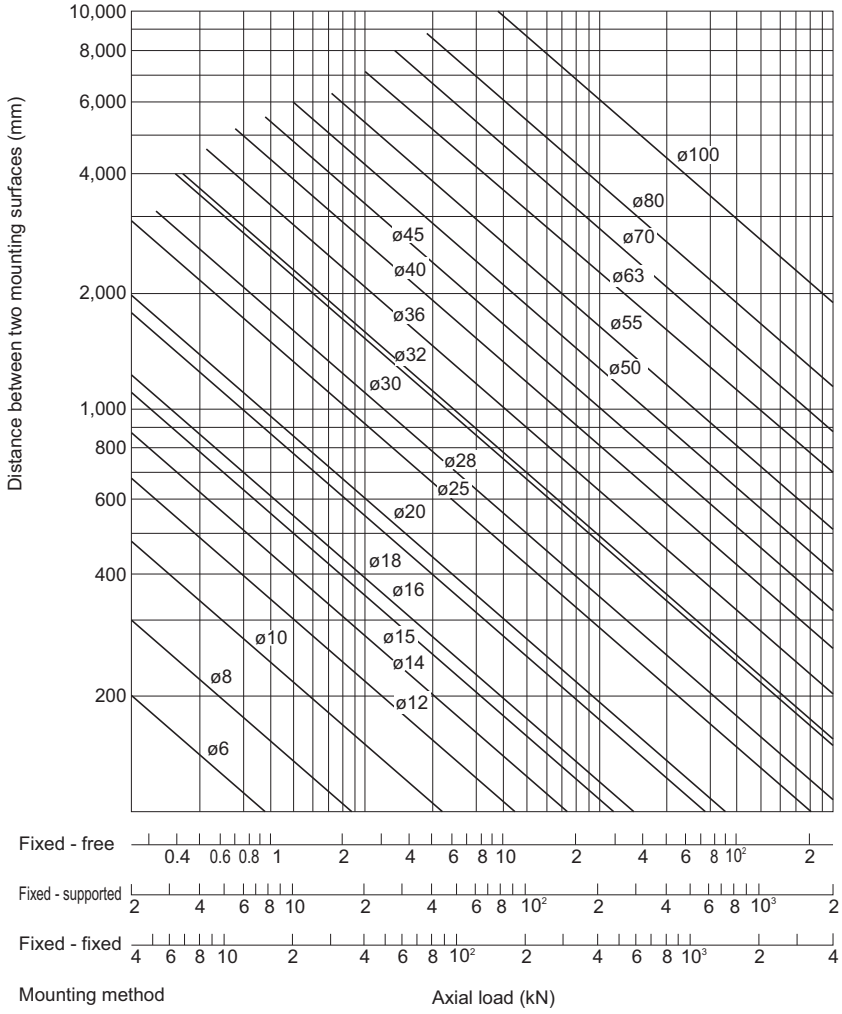


Fig. 5: Permissible Tensile Compressive Load Diagram