

## 5.5. Permissible Axial Load

### 5.5.1. 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 page K-44 shows the relationship between the screw shaft diameter and a buckling load. If determining a buckling load by calculation, it can be obtained from the equation (6) below. Note that in this equation, a safety factor of 0.5 is multiplied to the result.

$$P_1 = \frac{\eta_1 \cdot \pi^2 \cdot E \cdot I}{l_a^2} \cdot 0.5 = \eta_2 \frac{d_1^4}{l_a^2} 10^4 \quad \dots\dots\dots(6)$$

where

$P_1$  : Buckling load (N)

$l_a$  : Center distance (mm)

$E$  : Young's modulus ( $2.06 \times 10^5$  N/mm<sup>2</sup>)

$I$  : Minimum geometrical moment of inertia of the screw shaft (mm<sup>4</sup>)

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

$\eta_1, \eta_2$  = Factor for mounting method

Fixed - free       $\eta_1 = 0.25$        $\eta_2 = 1.3$

Fixed - supported       $\eta_1 = 2$        $\eta_2 = 10$

Fixed - fixed       $\eta_1 = 4$        $\eta_2 = 20$

### 5.5.2. Permissible Tensile and 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 and compressive load in relation to the yielding stress on the screw shaft.

The permissible tensile-compressive load is obtained from the equation (7).

$$P_2 = \sigma \frac{\pi}{4} d_1^2 = 116 d_1^2 \quad \dots\dots\dots(7)$$

where

$P_2$  : Permissible tensile and compressive load (N)

$\sigma$  : Permissible tensile-compressive stress (147 N/mm<sup>2</sup>)

$d_1$  : Screw-shaft thread minor diameter (mm)

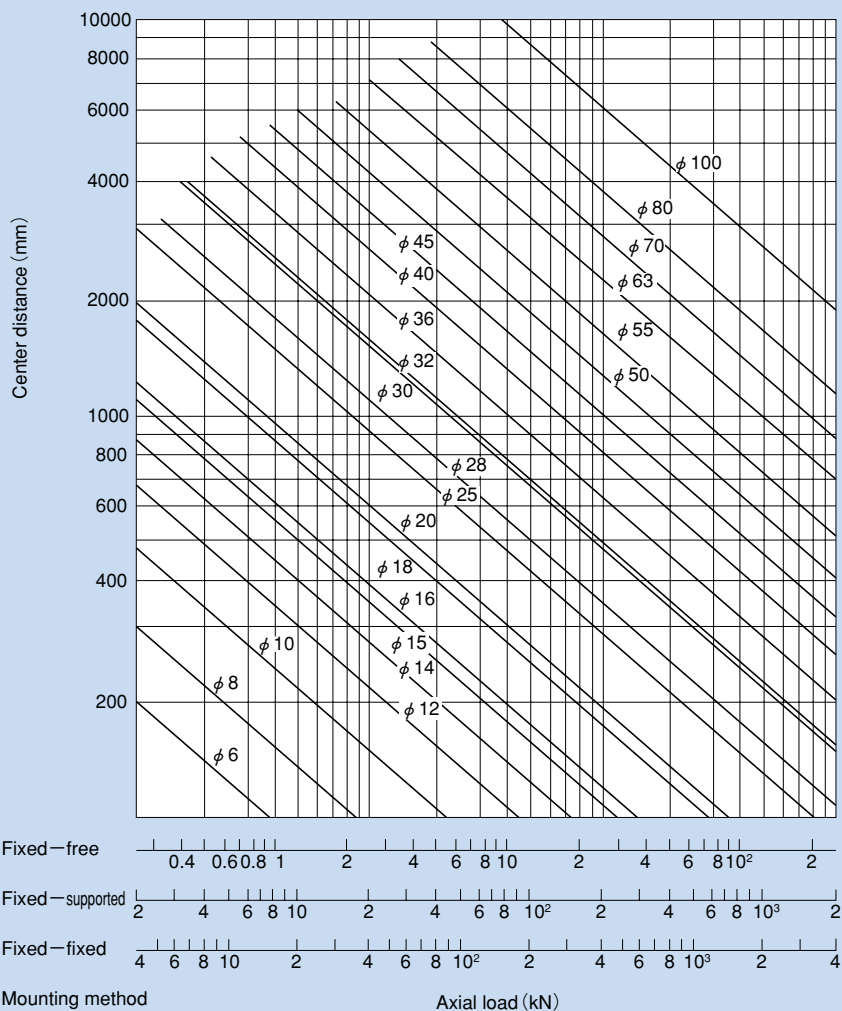


Fig. 5 Permissible Tensile and Compressive Load Diagram