Estimate of Hydrobushing Stiffness
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$\mu m := 10^{-6} m$

$\mu in := 10^{-6} in$

Stiffness at Center of End Clamped Round Rail

$E := 210 \cdot 10^{9} Pa \quad D := 2 in \quad L := 16 in \quad I := \frac{\pi}{64} \cdot D^{4}$

$$K_{rail} := \frac{192 \cdot E \cdot I}{L^{3}}$$

$K_{rail} = 196.4 \frac{N}{\mu m}$ $\quad K_{rail} = 1.1 \times 10^{6} \frac{lbf}{in}$

Stiffness of due to Fluid Film in Bushing

$gap := 0.001 in \quad L_{bushing} := 4 in \quad P := 100 psi$

$$K_{bushing} := \frac{P \cdot L_{bushing} \cdot D}{2 \cdot gap}$$

$K_{bushing} = 70.1 \frac{N}{\mu m}$ $\quad K_{bushing} = 4 \times 10^{5} \frac{lbf}{in}$

Stiffness of a Single Rail and Bushing Combination

$$K_{sys} := \left(\frac{1}{K_{bushing}} + \frac{1}{K_{rail}} \right)^{-1}$$

$K_{sys} = 51.6 \frac{N}{\mu m}$ $\quad K_{sys} = 2.9 \times 10^{5} \frac{lbf}{in}$

Each Carriage is Supported by 4 Rail/Bushing Sets

$$K_{car} := 4 \cdot K_{sys}$$

$K_{car} = 206.5 \frac{N}{\mu m}$ $\quad K_{car} = 1.2 \times 10^{6} \frac{lbf}{in}$

Stiffness Estimate for a Single Rectangular Air Bearing

$L_{air} := 50 mm \quad W_{air} := 100 mm$

$$K_{air} := \frac{(60 \cdot psi) \cdot L_{air} \cdot W_{air}}{2 \cdot (15 \mu m)}$$

$K_{air} = 68.9 \frac{N}{\mu m}$