Estimating the Stiffness and Thermal Errors in Ballscrew w/ a Rotary Encoder

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

What is the error due to the stiffness of the ballscrew at the when the finishing force is applied?

$K_{8x2.5} := 13.6 \frac{N}{\mu m}$ $K_{20x5} := 72 \frac{N}{\mu m}$

The minimum stiffness of the largest and smallest size ballscrews under consideration (see the Star Linear Catalogs and the Bamberg Ballscew Selector Spreadsheet for the computation of these values).

$F := 50 N$ $\delta_{Kmax} := \frac{F}{K_{8x2.5}}$ $\delta_{Kmax} = 3.7 \mu m$ $\delta_{Kmin} := \frac{F}{K_{20x5}}$ $\delta_{Kmin} = 0.7 \mu m$

How large are the errors due thermal growth (or shrink) of the ballscrew?

$L := 450 mm$ $\alpha_{steel} := 12 \frac{\mu m}{m \cdot K}$ $\Delta T := 2K$ $\delta_T := L \cdot \alpha_{steel} \cdot \Delta T$ $\delta_T = 10.8 \mu m$

It is assumed that the overall machine temperature can be controlled to within 2 C without too much trouble. This calculation DOES NOT account for the frictional heating of the ballscew (while in operation) which will cause the error to be worse!!!

These errors will NOT be detected and accounted for in a machine with a rotary encoder on the ballscrew.