

BOLTING-THERMAL LOADING 12/30/20

FROM ROYMECH.ORG:

$$F_T = \frac{k_B k_j}{(k_B + k_j)} \Delta T L_G (\alpha_j - \alpha_B)$$

CHANGE IN JOINT LOAD FROM ΔT JOINT STIFFNESS CHANGE IN LENGTH-RELATIVE- FROM ΔT

TOTAL BOLT LOAD $F_i = F_P + F_T$ PRELOAD FORCE

FROM MECHANICALC.COM:

$$L_G = 18\text{mm} + \left(\frac{6}{2}\right)\text{mm}$$

$$L_G = 21\text{mm}$$

$$k_B = \frac{A E_B}{L_G} = \boxed{2.268e8 \text{ N/m}} @ 3K$$

$$k_j = \frac{\pi E_j D_H \tan(30)}{2 \ln \left[\frac{(L_G \tan(30) + D_{BH} - D_H)(D_{BH} + D_H)}{(L_G \tan(30) + D_{BH} + D_H)(D_{BH} - D_H)} \right]}$$

$$= \boxed{4.575e8 \text{ N/m}} @ 3K$$

$$\frac{k_B k_j}{(k_B + k_j)} = \boxed{1.516e8 \text{ N/m}} \rightarrow \text{CONSERVATIVE, } > @ \text{ ROOM TEMP } (\pm \sim 10\%)$$

KNOWN: $\Delta_j = .435\%$, $\Delta_B = .238\%$ FROM 293K $\rightarrow$ 3K

$$\Delta T L_G (\alpha_j - \alpha_B) = -L_G (\Delta_j - \Delta_B) = \boxed{-4.137e-5 \text{ m}}$$

$$\therefore \boxed{F_T = -6.27 \text{ kN}} \quad \& \quad w/ F_P = 9.4 \text{ kN}$$

$$\boxed{F_i = 3.17 \text{ kN}} \quad \text{TENSION ON BOLT @ 3K}$$