Bolt Axial force Calculations

Ref: Bosch Automotive Handbook, 6th ed., p. 292 ff with corrections for the head friction term

$Mk := 200$ applied torque, lb ft

$d\_nom := 1.5$ nominal bolt diameter

$p := 6$ thread pitch (thread/in)

$d\_head := 0.5$ head contact diameter (in); in this case, the contact diam with the axle

$\mu g := 0.15$ fundamental coef of friction of the threads

$\mu k := 0.25$ coef of friction of the bolt head

$\alpha := 60 \cdot \frac{\pi}{180}$ thread profile (usually 60 deg.)

$h\_th := \frac{1}{2.0 \cdot p \cdot \tan\left(\frac{\alpha}{2}\right)}$ $h\_th = 0.144$ Thread height (ideal profile)

$d2 := d\_nom - 2 \cdot h\_th$ $d2 = 1.211$ bolt minor ("flank") diameter

$t := \frac{\mu g}{\cos\left(\frac{\alpha}{2}\right)}$ $t = 0.173$

$\rho := \operatorname{atan}(t)$ $\rho = 0.172$ effective coef of friction, threads

$Mk := 12 \cdot Mk$ convert torque to lb in

$\phi := \operatorname{atan}\left(\frac{1}{\pi \cdot d2 \cdot p}\right)$ $\phi = 0.044$ thread pitch angle

$\phi \cdot \frac{180}{\pi} = 2.508$ thread pitch angle in degrees

$r1 := 0.0$ $r2 := 0.5 \cdot d\_head$ radii for head friction term

$$Fv := \frac{Mk}{\frac{d2}{2} \cdot \tan(\phi + \rho) + \mu k \cdot \frac{2}{3} \cdot \left(\frac{r2^3 - r1^3}{r2^2 - r1^2}\right)}$$

axial force, pounds

$Fv = 1.379 \cdot 10^4$