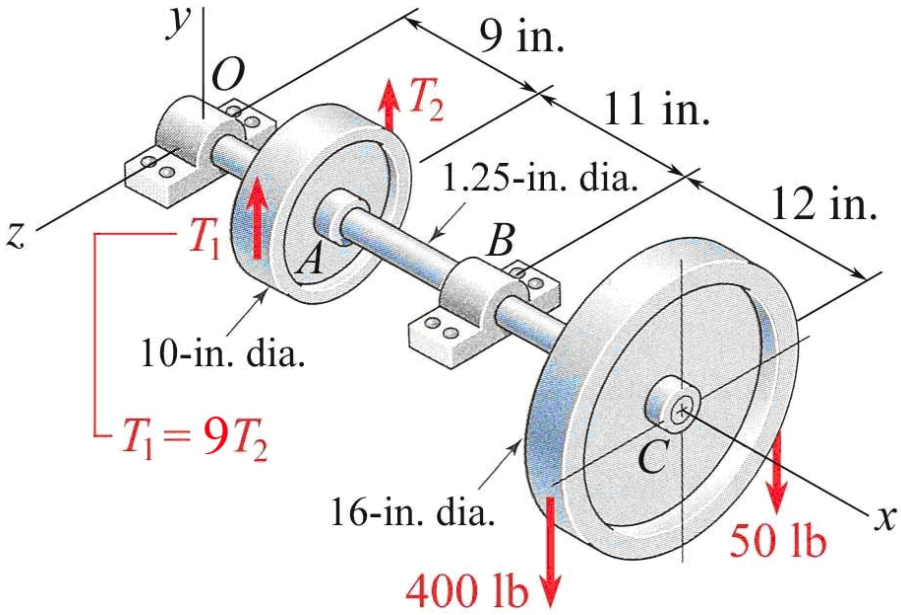
MEEG 4103 Quiz 4.1b.081 A steel countershaft with roller bearings at O and B is in equilibrium as shown, where $T_1 = 9T_2$. Taking the bearings as simple supports, determine (*a*) the deflection y_C at C, (*b*) the minimum shaft diameter $d_{\min}$ needed, using ⅛-in. increments, if the slope at either bearing should not exceed 0.07°, (*c*) the value of y_C when the shaft diameter is $d_{\min}$.



$E = 30\times10^6$ psi $I = \dfrac{\pi}{4}r^4$ $T_1 = 630$ lb $T_2 = 70$ lb ①

In *FBD* ① for shaft: $\mathbf{O}_y = 655$ lb ↓ ① $\mathbf{B}_y = 405$ lb ↑ ①

In *FBD* for CB: ① $O_y^c = \dfrac{35\,902.5}{EI}$ $M_C^c = -\dfrac{892\,170}{EI}$

(*a*) $2r = d = 1.25$ in. $y_C = M_C^c$ $y_C = -0.248$ in. ①

(*b*) At O: $\theta_O = V_O^c = O_y^c \le 0.07\pi/180$: $d \ge 2.114$ in. ①

At B: $\theta_B = V_B^c$, $\left|V_B^c\right| \le 0.07\pi/180$: $d \ge 2.327$ in. ①

Use $d_{\min} = 2\frac{3}{8}$ in. ① (*c*) $y_C = -0.01904$ in. ①