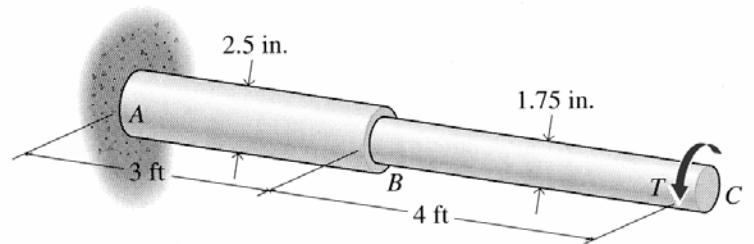


A solid circular aluminum alloy ($G = 4000$ ksi) shaft with diameters of 2.5 in. and 1.75 in. is subjected to a torque T . The allowable shearing stress is $\tau = 9000$ psi, and the maximum allowable angle of twist in the 7-ft length is $\phi_{AC} = 0.04$ rad. Determine the maximum allowable value of T .

Show steps clearly. Include units and box the final answer.



$$T_{AB} = T_{BC} = T$$

$$\tau_{AB} = \frac{T(1.25)}{\frac{\pi}{32}(2.5^4)} = 9000 \Rightarrow T = \underline{27610 \text{ in}\cdot\text{lb}}$$

$$\tau_{BC} = \frac{T(1.875)}{\frac{\pi}{32}(1.75^4)} = 9000 \Rightarrow T = \underline{9471 \text{ in}\cdot\text{lb}}$$

$$\phi_{AC} = \phi_{AB} + \phi_{BC}$$

$$= \frac{T(3)(12)}{(4 \times 10^6)\left(\frac{\pi}{32}\right)(2.5^4)} + \frac{T(4)(12)}{(4 \times 10^6)\left(\frac{\pi}{32}\right)(1.75^4)} = 0.04$$

$$\Rightarrow T = \underline{2601 \text{ in}\cdot\text{lb}}$$

$$\boxed{T_{\max} = 2601 \text{ in}\cdot\text{lb}}$$