K. Dennehy Ch. 5, Pgs. 199-205: 5-38, 5-46 HW

5-38

$$P = 6\ hp\left(\frac{550\ ft\text{-}lb/s}{1\ hp}\right) = 3{,}300\ \frac{ft\text{-}lb}{s}$$

$$T = \frac{P}{2\pi f} = \frac{\left(3{,}300\ \frac{ft\text{-}lb}{s}\right)\left(\frac{12\ in}{1\ ft}\right)}{2\pi\ \frac{rad}{rev}\left(1{,}200\ \frac{rev}{min}\right)\left(\frac{1\ min}{60\ s}\right)} = 315.13\ lb\text{-}in$$

$$\tau_{max} = \frac{Tc}{J} = \frac{T\cancel{c}}{\frac{\pi}{2}c^{\cancel{4}3}} = \frac{315.13\ lb\text{-}in}{\frac{\pi}{2}\left(\frac{5}{16}\ in\right)^3} = 6{,}573.8\ psi \text{ or } \boxed{6.57\ ksi}$$

5-46

$$P = 500\ hp\left(\frac{550\ ft\text{-}lb/s}{1\ hp}\right) = 275{,}000\ \frac{ft\text{-}lb}{s}$$

$$P = T\omega \rightarrow T = \frac{P}{\omega} = \frac{275{,}000\ \frac{ft\text{-}lb}{s}\left(\frac{12\ in}{1\ ft}\right)\left(\frac{1\ kip}{1{,}000\ lb}\right)}{200\ \frac{rad}{s}} = 16.5\ kip\text{-}in$$

$$\tau_{allow} = \frac{Tc}{J} \rightarrow \frac{J}{c} = \frac{T}{\tau_{allow}}$$

$$\frac{\frac{\pi}{2}\left((1\ in)^4 - c_i^4\right)}{(1\ in)} = \frac{16.5\ kip\text{-}in}{25\ \frac{kip}{in^2}}$$

$$\left((1\ in)^4 - c_i^4\right) = 0.42017\ in^4$$

$$c_i = 0.8726\ in$$

$$d_i = 2c_i = 1.745\ in$$

need to round down to nearest $\frac{1}{8}$ in
(larger wall thickness of tubular shaft)

$$\rightarrow \boxed{1\tfrac{5}{8}\ in}$$