7.D6 Let us first calculate the percent cold work and attendant yield strength and ductility if the drawing is carried out without interruption. From Equation 7.8

$$\%CW = \frac{\pi\left(\frac{d_0}{2}\right)^2 - \pi\left(\frac{d_d}{2}\right)^2}{\pi\left(\frac{d_0}{2}\right)^2} \text{ x } 100$$

$$= \frac{\pi\left(\frac{10.2 \text{ mm}}{2}\right)^2 - \pi\left(\frac{7.6 \text{ mm}}{2}\right)^2}{\pi\left(\frac{10.2 \text{ mm}}{2}\right)^2} \text{ x } 100 = 44.5\%CW$$

At 44.5%CW, the brass will have a yield strength on the order of 420 MPa (61,000 psi), Figure 7.19(a), which is adequate; however, the ductility will be about 5%EL, Figure 7.19(c), which is insufficient.

Instead of performing the drawing in a single operation, let us initially draw some fraction of the total deformation, then anneal to recrystallize, and, finally, cold work the material a second time in order to achieve the final diameter, yield strength, and ductility.

Reference to Figure 7.19(a) indicates that 27.5%CW is necessary to give a yield strength of 380 MPa. Similarly, a maximum of 27.5%CW is possible for 15%EL [Figure 7.19(c)]. Thus, to achieve both the specified yield strength and ductility, the brass must be deformed to 27.5 %CW. If the final diameter after the first drawing is d_0', then, using Equation 7.8

$$27.5\%CW = \frac{\pi\left(\frac{d_0'}{2}\right)^2 - \pi\left(\frac{7.6 \text{ mm}}{2}\right)^2}{\pi\left(\frac{d_0'}{2}\right)^2} \text{ x } 100$$

And, solving for d_0' yields

$$d_0' = \frac{7.6 \text{ mm}}{\sqrt{1 - \frac{27.5\%CW}{100}}} = 8.93 \text{ mm } (0.351 \text{ in.})$$