7.D7 This problem calls for us to cold work some brass stock that has been previously cold worked in order to achieve minimum tensile strength and ductility values of 450 MPa (65,000 psi) and 13%EL, respectively, while the final diameter must be 12.7 mm (0.50 in.). Furthermore, the material may not be deformed beyond 65%CW. Let us start by deciding what percent coldwork is necessary for the minimum tensile strength and ductility values, assuming that a recrystallization heat treatment is possible. From Figure 7.19(b), at least 27%CW is required for a tensile strength of 450 MPa. Furthermore, according to Figure 7.19(c), 13%EL corresponds a maximum of 30%CW. Let us take the average of these two values (i.e., 28.5%CW), and determine what previous specimen diameter is required to yield a final diameter of 12.7 mm. For cylindrical specimens, Equation 7.8 takes the form

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

Solving for the original diameter d_0 yields

$$d_0 = \frac{d_d}{\sqrt{1 - \frac{\%CW}{100}}} = \frac{12.7 \text{ mm}}{\sqrt{1 - 0.285}} = 15.0 \text{ mm} \quad (0.591 \text{ in.})$$

Now, let us determine its undeformed diameter realizing that a diameter of 19.0 mm corresponds to 35%CW. Again solving for d_0 using the above equation and assuming d_d = 19.0 mm yields

$$d_0 = \frac{d_d}{\sqrt{1 - \frac{\%CW}{100}}} = \frac{19.0 \text{ mm}}{\sqrt{1 - 0.35}} = 23.6 \text{ mm} \quad (0.930 \text{ in.})$$

At this point let us see if it is possible to deform the material from 23.6 mm to 15.0 mm without exceeding the 65%CW limit. Again employing Equation 7.8

$$\%CW = \frac{\pi\left(\frac{23.6 \text{ mm}}{2}\right)^2 - \pi\left(\frac{15.0 \text{ mm}}{2}\right)^2}{\pi\left(\frac{23.6 \text{ mm}}{2}\right)^2} \text{ x } 100 = 59.6\%CW$$