

6.23 This problem asks that we ascertain which of four metal alloys will not (1) experience plastic deformation, and (2) elongate more than 1.3 mm when a tensile load of 29,000 N is applied. It is first necessary to compute the stress using Equation 6.1; a material to be used for this application must necessarily have a yield strength greater than this value. Thus,

$$\sigma = \frac{F}{A_0} = \frac{29,000 \text{ N}}{\pi \left(\frac{12.7 \times 10^{-3} \text{ m}}{2} \right)^2} = 230 \text{ MPa}$$

Of the metal alloys listed, aluminum, brass and steel have yield strengths greater than this stress.

Next, we must compute the elongation produced in aluminum, brass, and steel using Equations 6.2 and 6.5 in order to determine whether or not this elongation is less than 1.3 mm. For aluminum

$$\Delta l = \frac{\sigma l_0}{E} = \frac{(230 \text{ MPa})(500 \text{ mm})}{70 \times 10^3 \text{ MPa}} = 1.64 \text{ mm}$$

Thus, aluminum is not a candidate.

For brass

$$\Delta l = \frac{\sigma l_0}{E} = \frac{(230 \text{ MPa})(500 \text{ mm})}{100 \times 10^3 \text{ MPa}} = 1.15 \text{ mm}$$

Thus, brass is a candidate. And, for steel

$$\Delta l = \frac{\sigma l_0}{E} = \frac{(230 \text{ MPa})(500 \text{ mm})}{207 \times 10^3 \text{ MPa}} = 0.56 \text{ mm}$$

Therefore, of these four alloys, only brass and steel satisfy the stipulated criteria.