6.41 This problem calls for us to compute the toughness (or energy to cause fracture). The easiest way to do this is to integrate both elastic and plastic regions, and then add them together.

$$\text{Toughness} = \int \sigma \, d\varepsilon$$

$$= \int_0^{0.007} E\varepsilon \, d\varepsilon + \int_{0.007}^{0.60} K\varepsilon^n \, d\varepsilon$$

$$= \left. \frac{E\varepsilon^2}{2} \right|_0^{0.007} + \left. \frac{K}{(n+1)} \varepsilon^{(n+1)} \right|_{0.007}^{0.60}$$

$$= \frac{103 \text{ x } 10^9 \text{ N/m}^2}{2} (0.007)^2 + \frac{1520 \text{ x } 10^6 \text{ N/m}^2}{(1.0 + 0.15)} \left[(0.60)^{1.15} - (0.007)^{1.15} \right]$$

$$= 7.33 \text{ x } 10^8 \text{ J/m}^3 \ \left(1.07 \text{ x } 10^5 \text{ in.-lb}_f\text{/in.}^3 \right)$$