ENGR 240
HW #9

1) Text 6.6

$\sigma = E\varepsilon$ $\quad E = (\text{Table } 6.1) = 107\ GPa$

$$\sigma = \frac{F}{A_0} = \frac{500\,N}{\frac{\pi}{4}(0.003\,m)^2} = 7.04 \times 10^7 \left(\frac{N}{m^2}\right) = Pa!$$

$$\varepsilon = \frac{\sigma}{E} = \frac{7.04 \times 10^7\ Pa}{107 \times 10^9\ Pa} = 6.6 \times 10^{-4}$$

$$\Delta l = \varepsilon l_0 = 6.6 \times 10^{-4}\,(25{,}000\,mm) = \boxed{16.5\,mm}$$

2) Text: 6.7

Bronze $\sigma_y = 275 \times 10^6\ Pa$

a) What F will just give σ_y?

$$\frac{F}{325\,mm^2} = \frac{F}{325\,mm^2\left(\frac{m}{1000\,mm}\right)^2} = 275 \times 10^6\ \frac{N}{m^2}$$

$\boxed{F = 89{,}000\,N}$

b) How much ε to get to σ_y? (Assume all elastic to that point)

$$\varepsilon = \frac{275 \times 10^6\ Pa}{115 \times 10^9\ Pa} = 0.0024 = \frac{l - 115\,mm}{115\,mm} \rightarrow \boxed{l = 115.3\,mm}$$

$l_0 = 115\,mm$

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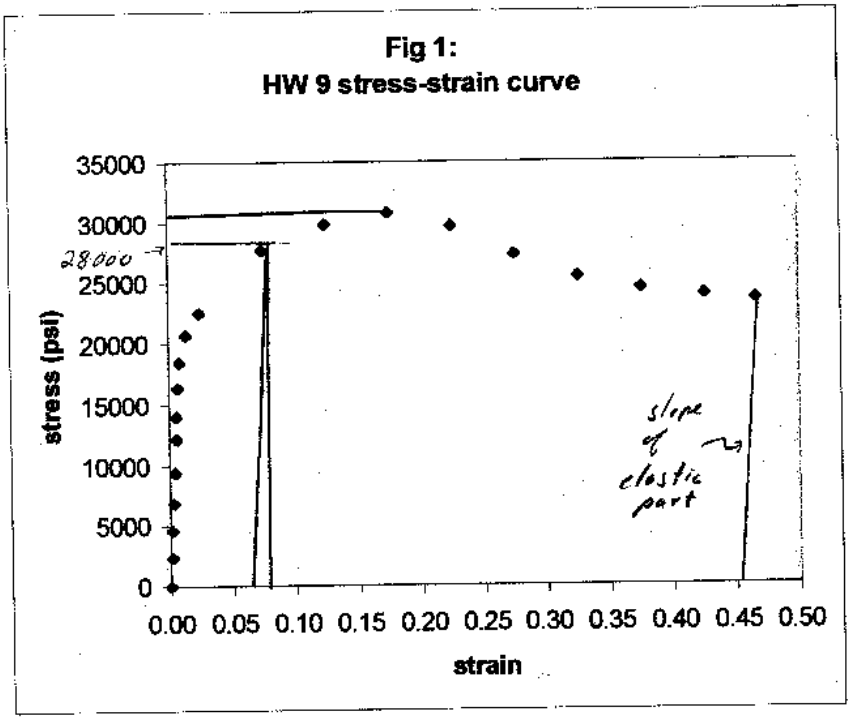
#2) $l_o = 2.00$ in $\rightarrow \varepsilon = \frac{\text{elongation}}{2.00}$ ← Δl

$A_o = \frac{\pi}{4}(d^2) = \frac{\pi}{4}(0.505\text{ in})^2 = 0.200\text{ in}^2 \rightarrow \sigma = \frac{F}{A_o}$ ← load



a) Fig 1, 2

b) Linear region slope =

$E \approx 1.6 \times 10^6$ psi

c) use 0.2 % OFFSET (Fig 2),

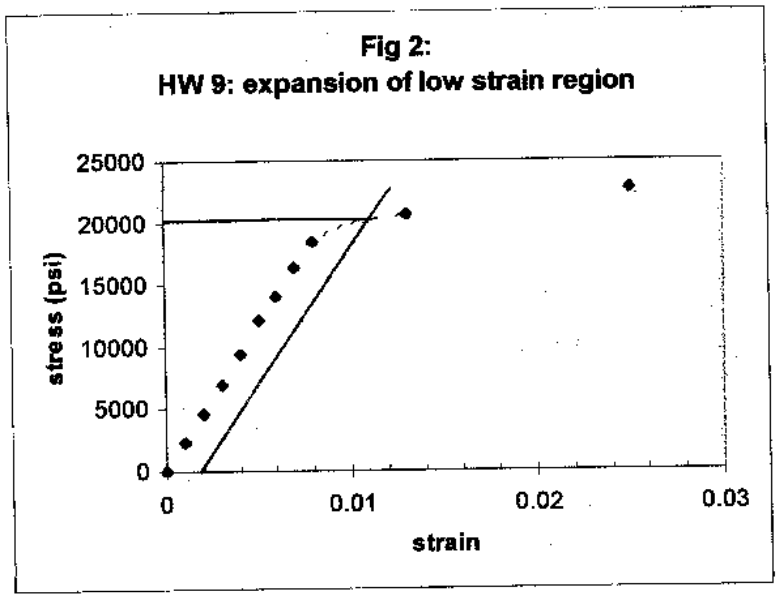
$\sigma_y \approx 20{,}500$ psi

d) Fig 1,

$TS \approx 31{,}000$ psi

e) $\varepsilon_{f,pl} \approx$ (Fig 1)

0.45 (45 %)



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#3) $l_o = 25"$

$A_o = 1/2 \times 1/2 = 0.25\ in^2$

a) $\sigma = \frac{7000\ lb}{0.25\ in^2} = \boxed{28{,}000\ psi}$

b) from Fig 1, $\varepsilon \cong 0.080 = \frac{l - 25}{25} \rightarrow \boxed{l = 27"}$

c) from Fig 1, $\varepsilon_{plastic} \approx 0.065 = \frac{l - 25}{25} \rightarrow \boxed{l = 26.6"}$

↑ close, w/ a little less plastic ε than total.