Trevor Swan

ENGR145 HW6

7.7) Plastic Deformation at 345 MPa (50,000 psi)

Modulus of elasticity is 103 GPa (15×10^6 psi)

a) $\sigma = \frac{F_{max}}{A_0}$ $F_{max} = \sigma \cdot A_0$

$\sigma = 345\ MPa = 345\ N/mm^2$

$A_0 = 130\ mm^2$

$F_{max} = (345 \frac{N}{mm^2})(130\ mm^2) = 44850\ N$

b) $\varepsilon = \frac{l_i - l_0}{l_0}$, $l_i = \varepsilon l_0 + l_0$

$\sigma = E\varepsilon$, $\varepsilon = \sigma/E$, $l_i = \frac{\sigma}{E} l_0 + l_0$

$\sigma = 345\ N/mm^2$

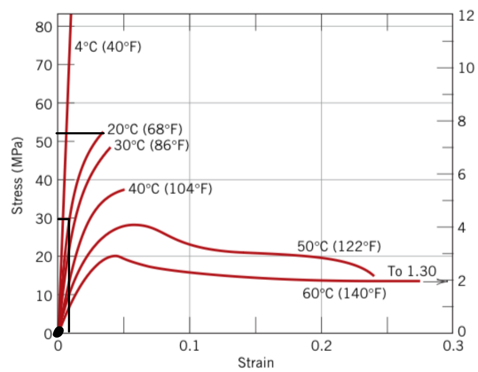
$E = 1.03\times10^5\ N/mm^2$

$l_0 = 76\ mm$

$l_i = \frac{345\ N/mm^2}{1.03\times10^5\ N/mm^2}(76) + 76$

$= 76.25\ mm$

7.62)



Given Stress Strain Curve, find E and TS

$E = \frac{\Delta\sigma}{\Delta\varepsilon} = \frac{30-0}{0.01-0} = 3000 = 3\ GPa$

Table Ranges from 2.24 – 3.24 GPa, good

TS at a max at the top of the stress-strain curve 53 MPa

Table Ranges from 48.3 – 72.4 MPa, good

9.14) $\sigma_{max} = 2\sigma_0 \left(\frac{a}{\rho_t}\right)^{1/2}$ Tensile fracture at 70 MPa applied, length 10^{-2} mm

Assume $\sigma_{max} = E/10$, $E = 69$ GPa from Table

$\sigma_{max} = 6.9\ GPa = 6.9\times10^3\ N/mm^2$

$\sigma_0 = 70\ N/mm^2$ $a = 10^{-2}\ mm$

$$\rho_t = \frac{10^{-2}\ mm}{\left(\frac{6.9\times10^3 \frac{N}{mm^2}}{2(70 \frac{N}{mm^2})}\right)^2} = 4.117\times10^{-6}\ mm$$

$4.117\times10^{-6}\ mm \times \frac{1\times10^6\ nm}{1\ mm} = 4.117\ nm$

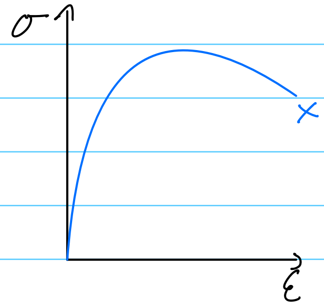
$\frac{\sigma_{max}}{2\sigma_0} = \left(\frac{a}{\rho_t}\right)^{1/2}$

$\left(\frac{\sigma_{max}}{2\sigma_0}\right)^2 = \frac{a}{\rho_t}$

$\rho_t = a \Big/ \left(\frac{\sigma_{max}}{2\sigma_0}\right)^2$

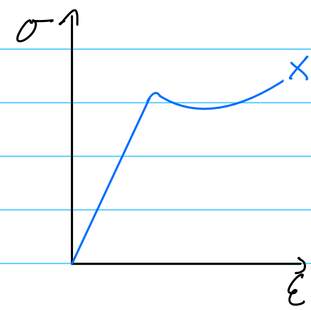
The profile of a stress-strain curve varies considerably depending upon the material studied. Using your book, lecture notes and a bit of outside research, sketch stress-strain curve for the following materials with a brief explanation of each: (1) a ductile metal such as copper; (2) a ductile plastic such as polycarbonate; (3) a rubber band; and (4) common window glass.

Ductile Metal



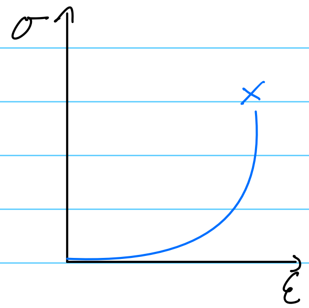
Undergo Considerable deformation before fracture (x). deformation, shown by curved part, allows absorption of stress

Ductile Plastic



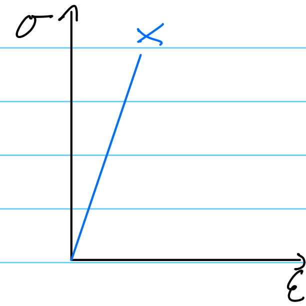
Can handle More stress Before fracture due to plastic deformation

Rubber Band



A S-curve. Little Stress applied → little Strain. Great stress results in fracture. Uncoiling Chains result in less strain

Window Glass



No mechanisms to dissipate stress. After enough stress is applied, fracture occurs. No deformation present.