Quiz 1—Design Process, Material Processing, Factor of Safety, Optimization

Name:_____

Problem 1: Material Processing

There are 4 stress-strain curves shown below. Use these diagrams to answer the following questions. **You must justify your answers in order to earn credit.**

a). Which of the stress strain curves represents **ductile materials?**

b). Which of the stress strain curves has the **highest strength**?

c). Which of the stress strain curves has the most **fracture toughness**?

d). Which of the stress strain curves would best represent a material that has been **annealed**?

Problem 2: Factor of Safety

A hollow steel tube is loaded along its longitudinal axis with a tensile force of 1000 lbs. The ultimate tensile strength of this particular steel is 43 000 psi. A factor of safety of 2 is required. What wall thickness is necessary if the outside diameter of the tube is 1.0 inch?

Key:

Problem 1: Material Processing

There are 4 stress-strain curves shown below. Use these diagrams to answer the following questions. **You must justify your answers in order to earn credit.**

a). Which of the stress strain curves represents **ductile materials?**

Curves a and c represent ductile materials; this is evidenced by the fact that the rupture strength is well beyond the yield strength

b). Which of the stress strain curves has the **highest strength**?

Curves c and d represent materials with high strengths. This is evidenced by the highest value of σ on the $\sigma - \varepsilon$ curve.

c). Which of the stress strain curves has the most **fracture toughness**?

Curve c exhibits the most fracture toughness; this is evidence by the amount of area under the $\sigma - \varepsilon$ curve.

d). Which of the stress strain curves would best represent a material that has been **annealed**?

Curve a best represents a material that has been annealed; its strength is lower, but it is relatively ductile and has some fracture toughness.

Problem 2: Factor of Safety

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Given S_{ut} = 43 ksi

N = 2

σ = F/A

$$A = \frac{p}{4}\left(d_o{}^2 - d_i{}^2\right)$$

$$N = \frac{S_{ut}}{s} = \frac{43000\frac{p}{4}\left(1^2 - d_i{}^2\right)}{1000} = 2$$

$$d_i = \sqrt{-\frac{(2)(4000))}{(43000)(p)} + 1}$$

$$d_i = .969937$$

$$2t = d_o - d_i = .03$$

$$t = 0.015$$