MSE 2001 Quiz 31 May 2011

1. Compute Young's modulus for a material that yields at an applied stress of 207 MPa and an elastic strain of 0.1%.

2. A ceramic cylinder, 10-mm in diameter and 1-m long, is axially loaded with a force of 2000 N. Assuming the material is linear elastic with a modulus of 380 GPa, what is the elongation in μm?

3. What is the critical flaw size in microns for an aluminum sample (K_{Ic} = 250 MPa√m) subjected to a tensile stress of 1500 MPa if the stress intensity parameter is $K = 1.12\sigma(\pi a)^{1/2}$?

4. A metal tensile bar, 10-mm in diameter and 5-cm long, exhibits a yield strength of 400 MPa, an elastic modulus of 70 GPa, and an ultimate tensile strength of 500 MPa. What is the maximum load that this sample withstands during this test?

5. Calculate the maximum allowable stress that can be imposed on a titanium alloy strut with fracture toughness 44 MPa√m if it is known to contain a penny-shaped crack [$K = 2\sigma(a/\pi)^{1/2}$] of diameter 1.6 cm.

$\sigma = F/A_0$, $\varepsilon = (l - l_o)/l_o$, $E = \sigma/\varepsilon$

1. 207 GPa
2. 67 μm
3. 7000 μm
4. 39,000 N
5. 436 MPa