**Due in class, Thursday, 8 April 2010**

### 29. The Begley-Landes experiment (1972)

Read J.D. Landes and J.A. Begley, The effect of specimen geometry on $J_{Ic}$. Special Technical Publication 514, pp. 24-39, American Society for Testing and Materials (1972). The paper is posted at http://imechanica.org/node/7900

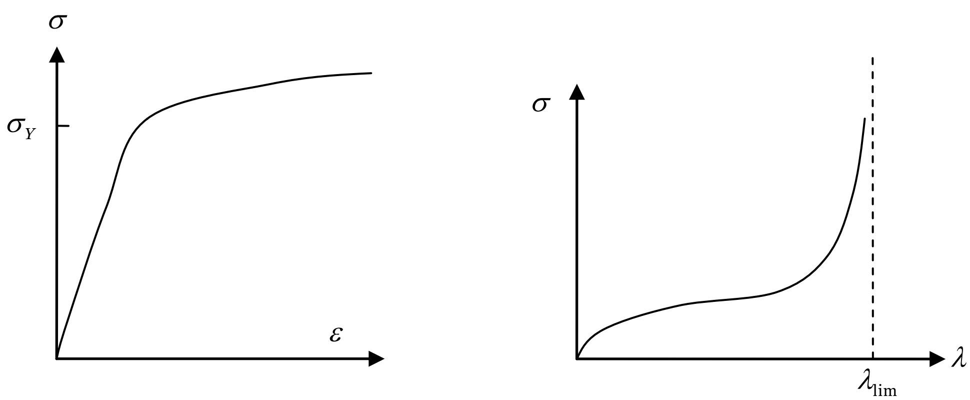
(a) Using the data in Table 1 to estimate the size of the plastic zone under the small-scale yielding condition.
(b) Do the specimens drawn in Fig. 2 satisfy the small-scale yielding condition?
(c) Explain how Figs 11-15 were obtained.
(d) List the main conclusions of the paper.

### 30. Field around the tip of a crack in an elastomer undergoing finite deformation

In class we described the stress and strain fields ahead the tip of a crack in a metal undergoing finite deformation. We also remarked that metals and elastomers have very different stress-strain relations. Now consider the field around the tip of a crack in an elastomer undergoing finite deformation.

(a) Sketch the crack in the undeformed body and crack in the deformed body.
(b) What should be the length scale that replaces $G/\sigma_Y$?
(c) Sketch the distribution of the stress $\sigma_{22}$ ahead of the tip of the crack.
(d) Sketch the distribution of the stretch ahead of the tip of the crack.

Comment on the implications of the fields on possible fracture mechanisms.




metal elastomer

### 31. Il'yushin theorem

State and prove the Il'yushin theorem.

### 32. He-Hutchinson Solution (1981, *J. Appl. Mech.* **48**, 830-840).

Consider a penny-shaped crack in an infinite material subject to remote opening stress $\sigma_{appl}$. The material obeys the power law. Using the Il'yushin theorem to show that the energy release rate takes the following form

$$G = \alpha \varepsilon_Y \sigma_Y a \left( \frac{\sigma_{appl}}{\sigma_Y} \right)^{n+1} h(n)$$

where $n$, $\sigma_Y$ and $\varepsilon_Y$ are the constants characterizing the power law material, and $h$ is a numerical coefficient depending on $n$ only. Write out $h(1)$ on the basis of the known linear elastic solution. The complete solution for $n \neq 1$ may be found in He and Hutchinson.