

Name:

## Homework 8

Due 16 Apr 2019

1. A wide, center-cracked specimen with Paris law parameters  $C = 10^{-9}$  and  $n = 4$  has an initial crack length of  $2a = 2$  in. The specimen is subjected to an  $R = 0$  cyclic stress such that  $\sigma = 3.4a^{-1}$ , where  $a$  is the current crack length. How many cycles will it take for the crack to reach  $2a = 8$  in?
2. An edge-cracked specimen with Paris law parameters  $C = 10^{-9}$  and  $n = 4$  has an initial crack length of  $a = 0.5$  in. The specimen is subjected to an  $R = 0$  cyclic stress such that  $\sigma = 3.0$  ksi. What will the crack length be after 50,000 cycles?
3. While flicking the clip on his pen, Dr. Smith (with his eagle vision) notices a 0.01" edge-crack. Assume that Dr. Smith's flicks are generally about 3 in-lbs, with one strong, 5 in-lb flick for every 10 regular flicks. If the pen clip is 0.25" wide, 0.05" thick and made from 7075-T6 (with  $K_c = 70 \text{ ksi}\sqrt{\text{in}}$ ), use the Boeing-Walker growth rate equation with  $p = 3.5$ ,  $q = 0.6$ ,  $\mu = 0.1$ , and  $m_T = 24$  to estimate the number of cycles remaining for Dr. Smith's pen.
4. Consider a wide, center-cracked panel with an initial crack length of  $2a = 0.5$  in. Use the Boeing-Walker growth rate equation with  $p = 3.5$ ,  $q = 0.6$ ,  $\mu = 0.1$ , and  $m_T = 24$ . Compare the expected crack growth rate for the expected load ( $\sigma_{min} = 5$  ksi and  $\sigma_{max} = 20$  ksi) with a situation where an unexpected overload ( $\sigma_{min} = 5$  ksi and  $\sigma_{max} = 40$  ksi) occurs after 5,000 cycles
  - (a) Using the Wheeler retardation model with  $m = 1.5$  and a plane stress plastic zone for  $\sigma_{ys} = 68$  ksi
  - (b) Using the Willenborg retardation model with  $S_{OL} = 2.0$  and  $K^{th} = 3 \text{ ksi}\sqrt{\text{in}}$ .
  - (c) Using the closure retardation model with  $C_{f0} = 0.3$