

Name:

Homework 5

Due 27 Feb 2020

1. Use the MIL-HDBK pages copied in your text (pp. 136-143) to look up the following yield stress values. Use the A-basis for all values.
 - (a) 2024-T351 bare, $t=0.25$, LT direction
 - (b) 2024-T351 bare, $t=0.25$, L direction
 - (c) 7075-T651 bare, $t=0.5$, LT direction
 - (d) 7075-T651 bare, $t=0.5$, L direction
2. Use the charts provided in your text (pp. 111-121) to look up fracture toughness for the following conditions, at room temperature.
 - (a) 2024-T351 bare, $t=0.25$, T-L direction
 - (b) 2024-T351 bare, $t=0.25$, L-T direction
 - (c) 7075-T651 bare, $t=0.5$, T-L direction
 - (d) 7075-T651 bare, $t=0.5$, L-T direction
3. Use the Fedderson approach to plot residual strength vs. crack length for a center-cracked panel ($W = 5$ in.)
 - (a) For 2024-T351 bare aluminum, with $t=0.25$, in the T-L and L-T directions, at room temperature.
 - (b) For 7075-T651 bare aluminum, with $t=0.5$, in the T-L and L-T directions, at room temperature.
4. Based on a proposed inspection cycle and fatigue analysis for a 7075-T651 bare aluminum panel, we need to design a proof test to ensure there are no center-cracks greater than 0.25" long. What proof load must be applied to ensure this condition ($W = 8$ in., $t = 0.4$ in., check both grain directions, at room temperature).

5. A 120" diameter fuselage has an axial crack. The crack is centered on a circumferential stiffener. Stiffener spacing is 10", cross-section is 0.3788 in², skin thickness is 0.1875", and rivet spacing is 1". Use the charts on pp. 167-178 and the tables on pp. 194 - 196 to plot the σ_c vs. a curve for the skin under the following cases. Note: use $K_c = 68 \text{ ksi}\sqrt{\text{in}}$. Assume a skin stiffness of $E = 11 \text{ Msi}$ and a stiffener stiffness of $E_s = 23.4 \text{ Msi}$ and a stiffener yield strength of $\sigma_{YS} = 120 \text{ ksi}$.
- (a) without stiffeners
 - (b) with stiffeners
 - (c) with stiffeners, but the stiffener centered over the crack is broken

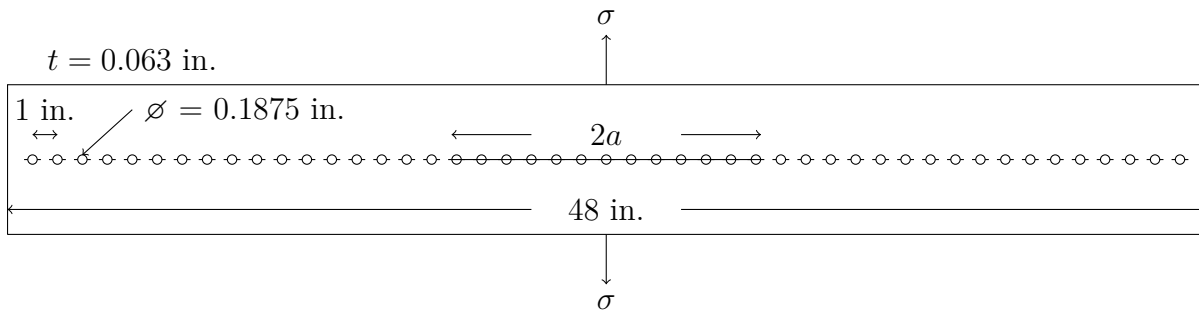
Note: Ignore net section yield for the skin in this problem

6. Plot the residual strength of the bolted lap joint shown. Compare the following cases
- (a) Net Section Yield
 - (b) Brittle Fracture
 - (c) Linkup
 - (d) Modified Linkup

Where the MSD crack length $c = 0.05 \text{ in.}$ Compare Al 2024-T3, Al 2524-T3, and Al 7075-T6, using the data in Table 1. Although β will be a function of crack length, assume $\beta_a = 0.934$ and $\beta_l = 2.268$ for these calculations.

Table 1: Material properties for Problem 6

Material	σ_{YS} (ksi)	K_C (ksi $\sqrt{\text{in}}$)
2024-T3	40	120
2524-T3	40	140
7075-T6	63	60



7. For the following panel assume $K_{IC} = 70 \text{ ksi}\sqrt{\text{in}}$ and $a = 0.75 \text{ in}$.

- Determine the critical values of σ and τ as well as the crack extension angle using the maximum circumferential stress criterion.
- Determine the critical values of σ and τ as well as the crack extension angle using the principal stress criterion.

Note: Assume $\beta = \beta' = 1$

