

Problem M20

Al Alloy 2024 (T3) is used for the fuselage of a commercial transport. The mean stress during steady flight is predicted to be 150 MPa. In addition unsteady aerodynamic loading may result in a cyclic stresses of ± 100 MPa in total amplitude at the same location. Assume that the unsteady loads are the main source of fatigue crack growth. Laboratory experiments show that the fatigue crack growth behavior is well modeled by an equation of the form:

$$\frac{da}{dN} = 2.7 \times 10^{-12} (\Delta K)^{5.0}$$

where $\Delta K = Y \Delta \sigma \sqrt{\pi a}$ In this geometry assume that $Y=1.2$. da/dN is given in m/cycle and ΔK is given in $\text{MPa}\sqrt{\text{m}}$

If the smallest crack that can be reliably detected blade is 3.00 mm estimate the number of cycles until fast fracture occurs. Recommend an inspection interval accordingly.