p8-15

Equations

Problem 8-15

Some aircraft component is fabricated from an aluminum alloy that has a plane strain fracture toughness of..

$$K_{Ic} = 40 \ \left[\mathrm{MPa}\sqrt{(\mathrm{m})}\right] \tag{1}$$

It has been determined that fracture results at a stress of ..

$$\sigma_f = 300 \ [\mathrm{MPa}] \tag{2}$$

when the maximum internal crack length is ..

$$a = 4 \cdot \left| 0.001 \ \frac{m}{mm} \right| \tag{3}$$

Write the plane strain fracture toughness equation

$$K_{Ic} = Y \cdot \sigma_f \cdot \sqrt{(\pi \cdot a)} \tag{4}$$

Please note that Y is close to unity. Although it depends on crack length and specimen geomtry, we will assume that we can use it for the next part of the problem.

$$a_{new} = 6 \cdot \left| 0.001 \ \frac{m}{mm} \right| \tag{5}$$

$$\sigma_{new} = 260 \ [\mathrm{MPa}] \tag{6}$$

Now calculate the needed fracture toughness

$$K_c = Y \cdot \sigma_{new} \cdot \sqrt{(\pi \cdot a_{new})} \tag{7}$$

This exceeds K_{Ic}, so fracture will occur.

Solution

$a = 0.004$	$a_{new} = 0.006$
$K_c = 42.46$	$K_{Ic} = 40$
$\sigma_f = 300$	$\sigma_{new} = 260$
$Y = 1.189$	