Given: $S_{yt} = 1{,}460\ MPa$ $K_{IC} = 98\ MPa\sqrt{m}$.

Find: Size of a surface crack that will lead to catastrophic failure at $\sigma = 0.5 S_{yt}$.

Solution: $K_{IC} = Y\sigma\sqrt{\pi a}$

$$\Rightarrow \left(\frac{K_{IC}}{Y\sigma}\right)^2 \frac{1}{\pi} = a$$

Since no crack geometry has been given, assume $Y = 1.0$.

$$\Rightarrow a = \frac{1}{\pi}\left(\frac{98\ MPa\sqrt{m}}{1.0(0.5)(1{,}460\ MPa)}\right)^2$$

$\underline{\underline{a = 5.74\ mm}}$

Given: Minimum detectable flaw size = 25 μm.

$K_{IC} = 9\ MPa\sqrt{m}$

Find: Maximum service stress.

Solution:

$$K_{IC} = Y\sigma\sqrt{\pi a}$$

Since no crack geometry has been given, assume $Y = 1.0$.

$$\Rightarrow \sigma = \frac{K_{IC}}{Y\sqrt{\pi a}}$$

$$= \frac{9\ MPa\sqrt{m}}{1.0\sqrt{\pi(25\times10^{-6}\ m)}}$$

$$\sigma = \underline{\underline{1{,}020\ MPa.}}$$