

Static “failure” theories.

What is meant by “failure”?

**Maximum normal stress theory:** “failure” occurs if  $\sigma_1 > S_{ut}$  (FRACTURE)

**Maximum shear stress theory (aka Tresca theory):** use convention:  $\sigma_1 \geq \sigma_2 \geq \sigma_3$  “failure” occurs when

$$\tau_{\max} = (\sigma_1 - \sigma_3)/2 > S_{ys}/2 \quad \text{(Yielding)}$$

$$\text{Tresca stress: } 2\tau_{\max} = (\sigma_1 - \sigma_3) > S_{ys} \quad \text{(Yielding)}$$

**Distortion energy (aka von Mises Theory)**

$$\text{Effective stress} = \text{von Mises stress} = \sigma_{\text{eff}} = \{1/2[(\sigma_1 - \sigma_3)^2 + (\sigma_1 - \sigma_2)^2 + (\sigma_2 - \sigma_3)^2]\}^{1/2}$$

“Failure” occurs when  $\sigma_{\text{eff}} > S_{ys}$  (Yielding)