Yielding Criteria:

1) Tresca Criteria:

(maximum shear stress)

$$\tau_{max} = \frac{\sigma_1 - \sigma_3}{2}$$

σ_1 = max principal stress

σ_3 = min principal stress.

For yielding to occur $\frac{\sigma_0}{2} \geq \tau_{max}$

$$\frac{\sigma_0}{2} \geq \frac{\sigma_1 - \sigma_3}{2}$$

$$\boxed{\sigma_0 \geq \sigma_1 - \sigma_3}$$

2) Von-Mises Criteria:

$$(\sigma_1 - \sigma_2)^2 + (\sigma_2 - \sigma_3)^2 + (\sigma_3 - \sigma_1)^2 = 2\sigma_y^2$$

σ_y = yield strength from simple uniaxial test.

Equivalent stress σ_{vm}

$$\sigma_{vm} = \frac{1}{\sqrt{2}} \sqrt{(\sigma_1 - \sigma_2)^2 + (\sigma_2 - \sigma_3)^2 + (\sigma_3 - \sigma_1)^2}$$

Yield condition: $\sigma_{vm} \geq \sigma_y$

"The von-mises criterion says that a ductile material yields when the equivalent stress {derived from distortion energy} reaches the yield stress from a simple tension test.

Pierls - Nabbaro (PN) Stress:

→ The movement of dislocation requires stress which depends on nature of interatomic bond.

$$\tau_{PN} = G e^{-\left(\frac{2\pi w}{b}\right)}$$

w → width of dislocation.

$w = \frac{d}{1-\nu}$ — d → interplanar dist, ν → poisson's ratio.

$w =$ 0	b	$5b$	$10b$
τ G	$\frac{G}{400}$	$\frac{G}{10^{14}}$	$\frac{G}{10^{27}}$

→ Dislocations glide occurs most easily in wide dislocations.

* $a\uparrow \Rightarrow d\uparrow \Rightarrow \tau_{PN}\downarrow$ ses

  $b\downarrow \Rightarrow \tau_{PN}\downarrow$ ses

→ Closed packed planes are widely spaced

→ b is shortest in closed packed direction.

* Slip occurs on closed packed planes and closed packed directions.