ENGINEERS EDGE

Press Fit Engineering Design Equations and Calculator

Engineering Calculators | Torque Engineering and Design
Strength of Materials

Open Press Fit Calculator
Requires a Java Enabled Browser

(1) Inner Body Poisson Radial Displacement

$$u_{Poisson} - \frac{2F\eta_{outer} D_{I,outer}}{\pi(D_{O,outer}{}^2 \quad D_{I,outer}{}^2)E_{outer}} - \frac{2F\eta_{inner} D_{O,inner}}{\pi(D_{O,inner}{}^2 \quad D_{I,inner}{}^2)E_{inner}}$$

(2) Thermal Radial Mismatch

$$u_{thermal} = \Delta T(CTE_{inner} - CTE_{outer}) \cdot D_{interface}/2 \text{, use } D_{interface} = D_{I,outer}$$

(3) Outer Body Radial Displacement Caused by Rotation

$$u_{centri,outer} = \frac{\rho\omega^2}{8E^*}\left\{-\left(\frac{D_{I,outer}}{2}\right)^3 + (3+\eta_{outer})\left[\frac{\left(D_{O,outer}{}^2 + D_{I,outer}{}^2\right)}{4(1+\eta_{outer})} \cdot \frac{D_{I,outer}}{2} + \frac{D_{O,outer}{}^2 D_{I,outer}}{8(1-\eta_{outer})}\right]\right\}$$

(4) Inner Body Radial Displacement Caused by Rotation

$$u_{centri,outer} = \frac{\rho\omega^2}{8E^*}\left\{-\left(\frac{D_{O,inner}}{2}\right)^3 + (3+\eta_{inner})\left[\frac{\left(D_{O,inner}{}^2 + D_{I,inner}{}^2\right)}{4(1+\eta_{inner})} \cdot \frac{D_{O,inner}}{2} + \frac{D_{O,inner} D_{I,inner}{}^2}{8(1-\eta_{inner})}\right]\right\}$$

(5) Interface Pressure as a result of Diametrical Interference

$$P = \frac{\Delta}{\frac{D_{I,outer}}{E_{outer}}\left(\frac{D_{O,outer}{}^2 + D_{I,outer}{}^2}{D_{O,outer}{}^2 - D_{I,outer}{}^2} + \eta_{outer}\right) + \frac{D_{O,inner}}{E_{inner}}\left(\frac{D_{O,inner}{}^2 + D_{I,inner}{}^2}{D_{O,inner}{}^2 - D_{I,inner}{}^2} - \eta_{inner}\right)}$$

For the Outer Body Subjected to Internal Pressure, Axial Force, Torque, and Rotation.

(6) Radial Displacement of the inner Surface Caused by Internal Pressure.

$$u_{inner} = \frac{D_{I,outer}P}{2E_{outer}}\left(\frac{D_{I,outer}{}^2 + D_{O,outer}{}^2}{D_{O,outer}{}^2 - D_{I,outer}{}^2} + \eta_{outer}\right)$$

(7) Radial Stress Caused by internal Pressure

$$\sigma_{r,pressure} = \frac{D_{I,outer}{}^2 P}{D_{O,outer}{}^2 - D_{I,outer}{}^2}\left(1 - \frac{D_{O,outer}{}^2}{D_{I,outer}{}^2}\right)$$

(8) Circumferential Stress Caused by Axial Force

$$\sigma_{\theta,pressure} = \frac{D_{I,outer}{}^2 P}{D_{O,outer}{}^2 - D_{I,outer}{}^2}\left(1 + \frac{D_{O,outer}{}^2}{D_{I,outer}{}^2}\right)$$

(9) Axial Stress Caused by Torque

$$\sigma_z = \frac{4F}{\pi(D_{O,outer}{}^2 - D_{I,outer}{}^2)}$$

(10) Shear Stress Caused by Torque

$$\tau = \frac{16TD_{I,outer}}{\pi(D_{O,outer}{}^4 - D_{I,outer}{}^4)}$$

(11) Circumferential Centrifugal Stress at the Inner Surface

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$$\sigma_{\theta,centrifugal} = \frac{\rho\omega^2(3+\eta_{outer})}{8}\left(\frac{D_{I,outer}^{\ 2}}{4}+\frac{D_{O,outer}^{\ 2}}{2}-\frac{(1+3\eta_{outer})}{(3+\eta_{outer})}\frac{D_{I,outer}^{\ 2}}{4}\right)$$

(12) Von Mises Stress at the Inner Surface

$$\sigma_{VonMises} = \sqrt{\frac{(\sigma_r-\sigma_{\theta,pressure}-\sigma_{\theta,centrifugal})^2+(\sigma_{\theta,pressure}+\sigma_{\theta,centrifugal}-\sigma_z)^2+(\sigma_r-\sigma_z)^2}{2}+3\tau^2}$$

For the Inner Body Subjected to External PRessure , Axial Force, torque and Rotation

(13) The Radial Stress Caused by Internal Pressure

$$u_{outer} = -\frac{D_{O,inner}P}{2E_{outer}}\left(\frac{D_{O,inner}^{\ 2}-D_{I,inner}^{\ 2}}{D_{O,inner}^{\ 2}-D_{I,inner}^{\ 2}}-\eta_{inner}\right)$$

(14) Radial Stress Caused by Internal Pressure

$$\sigma_{r,pressure} = \frac{D_{O,inner}^{\ 2}P}{D_{O,inner}^{\ 2}-D_{I,inner}^{\ 2}}\left(1-\frac{D_{I,inner}^{\ 2}}{D_{O,inner}^{\ 2}}\right)$$

(15) Circumferential Stress Caused by Internal Pressure

$$\sigma_{\theta,pressure} = \frac{D_{O,inner}^{\ 2}P}{D_{O,inner}^{\ 2}-D_{I,inner}^{\ 2}}\left(1+\frac{D_{I,inner}^{\ 2}}{D_{O,inner}^{\ 2}}\right)$$

(16) Axial Stress Caused by Axial Force

$$\sigma_z = \frac{4F}{\pi(D_{O,inner}^{\ 2}-D_{I,inner}^{\ 2})}$$

(17) Shear Stress Caused by Axial Force

$$\tau = \frac{16TD_{O,inner}}{\pi(D_{O,inner}^{\ 4}-D_{I,inner}^{\ 4})}$$

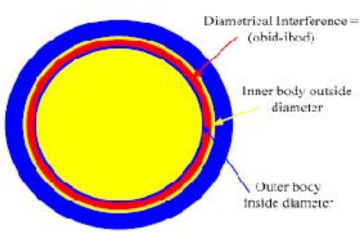
(18) Circumferential Centrifugal Stress at the outer Surface

$$\sigma_{\theta,centrifugal} = \frac{\rho\omega^2(3+\eta_{inner})}{8}\left(\frac{D_{I,inner}^{\ 2}}{2}+\frac{D_{O,inner}^{\ 2}}{4}-\frac{(1+3\eta_{inner})}{(3+\eta_{inner})}\frac{D_{O,inner}^{\ 2}}{4}\right)$$

(19) Von Mises Stress at the outer Surface

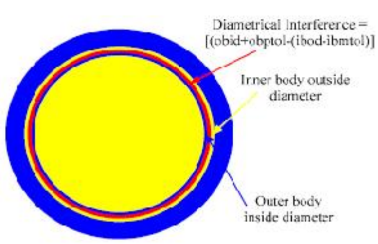
$$\sigma_{VonMises} = \sqrt{\frac{(\sigma_r-\sigma_{\theta,pressure}-\sigma_{\theta,centrifugal})^2+(\sigma_{\theta,pressure}+\sigma_{\theta,centrifugal}-\sigma_z)^2-(\sigma_r-\sigma_z)^2}{2}+3\tau^2}$$

Ideal Case



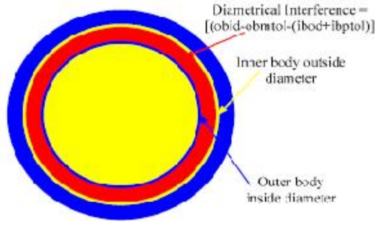
Worst Case for Loose Fit:

Joint may not be able to transmit desired force or torque



Worst Case for Tight Fit:

Yield stress may be exceeded and outer body may rupture



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