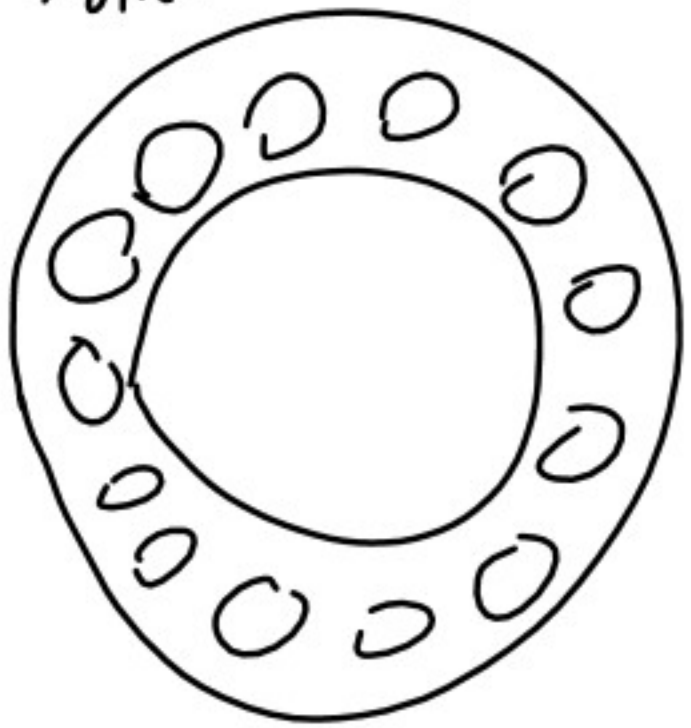
Contact Stress

$\sigma = \frac{F}{A}$

roller bearing



l thick

ν poisson ratio

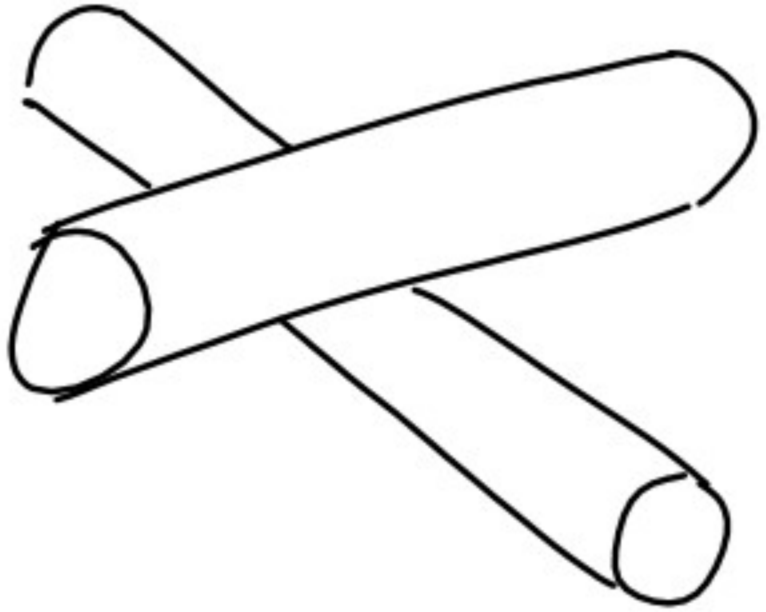
E Youngs Modulus

d diameter

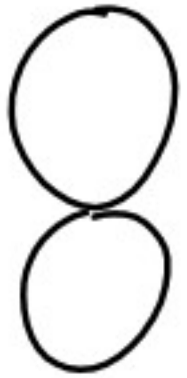
$$b = \sqrt{\frac{2F}{\pi l} \, \frac{(1-\nu_1^2)/E_1 + (1-\nu_2^2)/E_2}{1/d_1 + 1/d_2}}$$

$$\sigma_{max} = \frac{2F}{\pi b l}$$

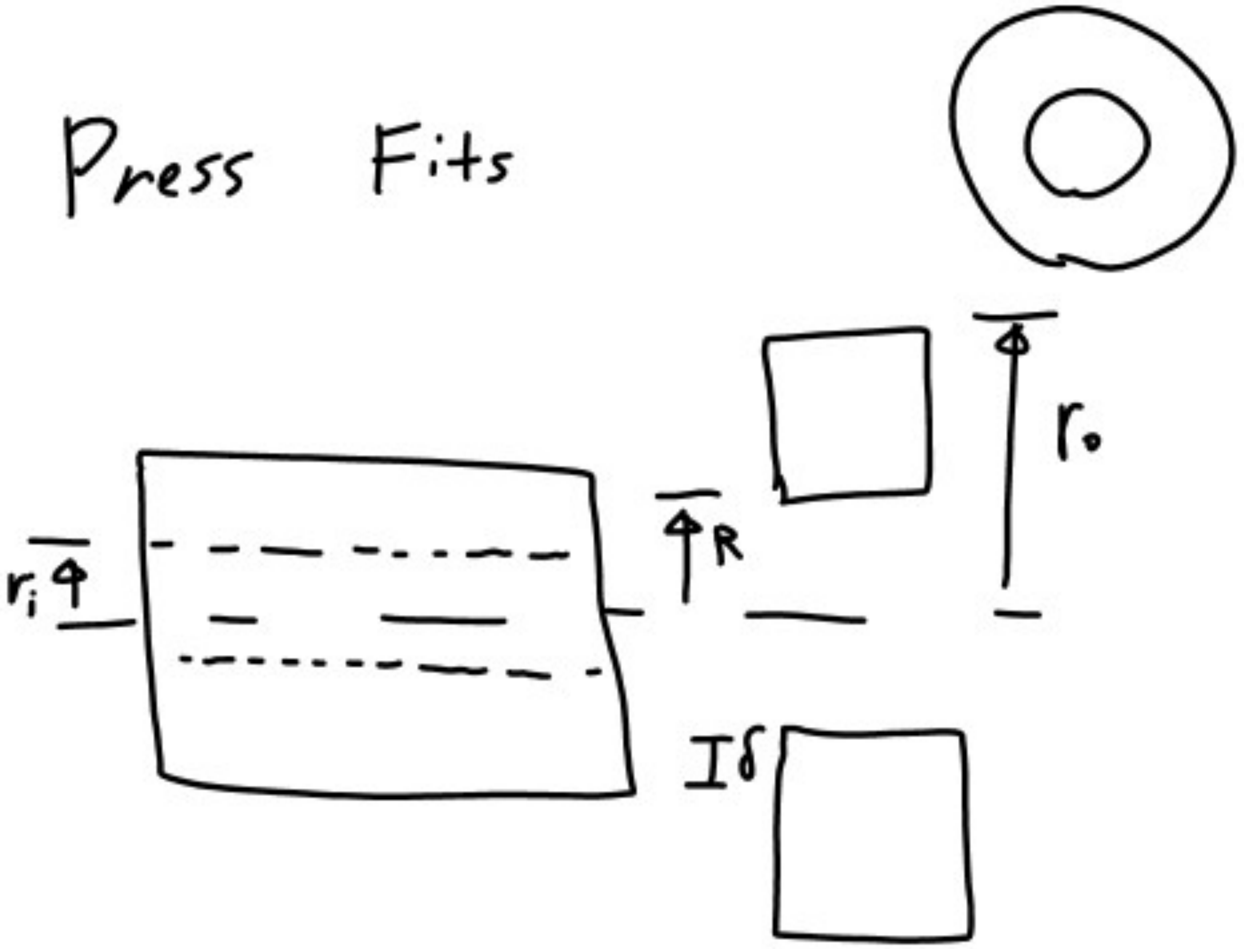
2 crossed cylinders



2 spheres



Press Fits

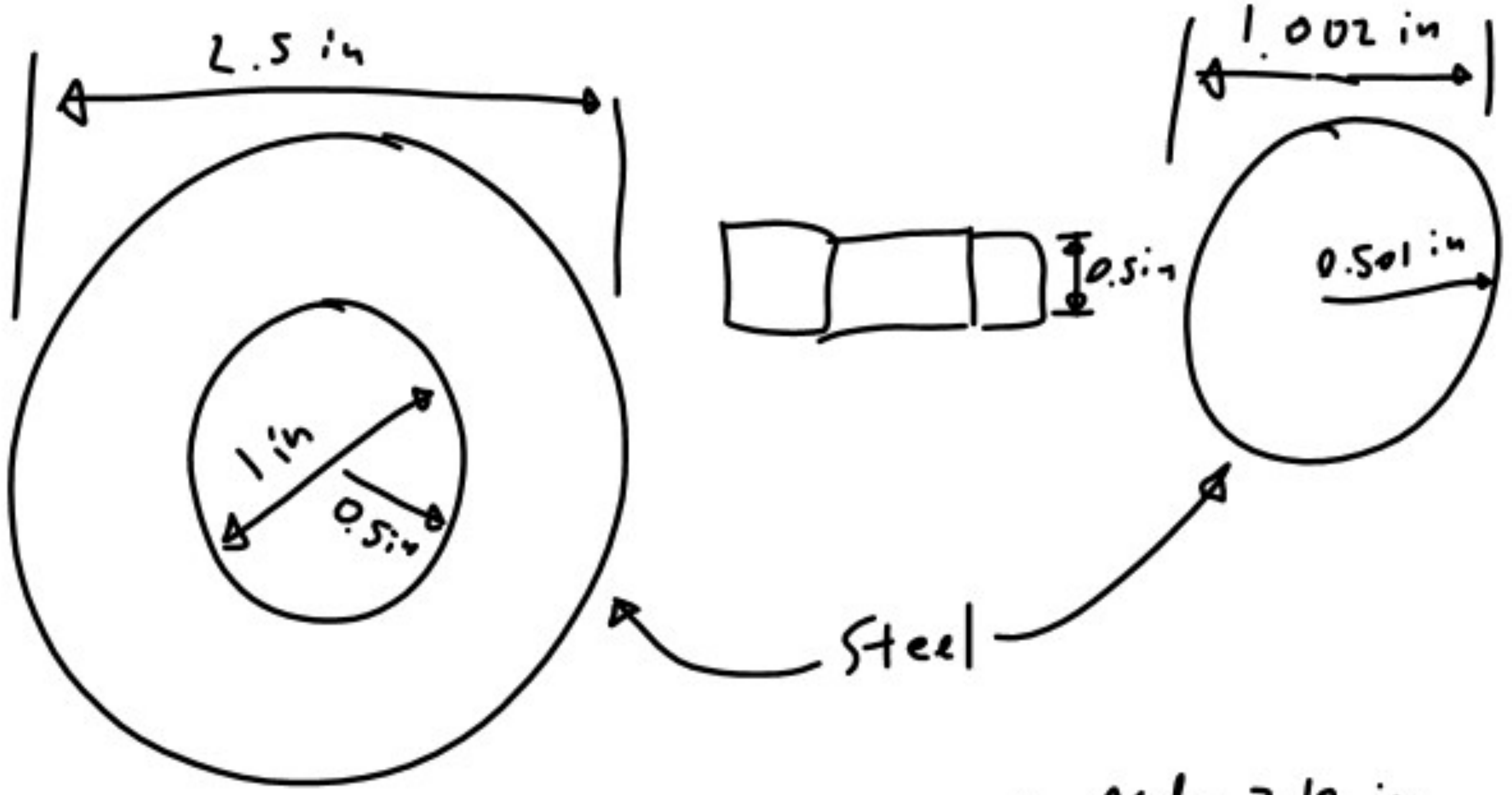


$$p = \frac{\delta}{R\left(\frac{1}{E_o}\left(\frac{r_o^2+R^2}{r_o^2-R^2}+\nu_o\right)+\frac{1}{E_i}\left(\frac{R^2+r_i^2}{R^2-r_i^2}-\nu_i\right)\right)}$$

if same material

$$p = \frac{E\delta\,(r_o^2-R^2)(R^2-r_i^2)}{2R^3(r_o^2-r_i^2)}$$

$$(\sigma_t)_i\Big|_{r=R} = -p\,\frac{R^2+r_i^2}{R^2-r_i^2} \qquad (\sigma_t)_o\Big|_{r=R} = p\,\frac{r_o^2+R^2}{r_o^2-R^2}$$



$$p = \frac{E\,\delta(r_o^2 - R^2)(R^2 - r_i^2)}{2R^3(r_o^2 - r_i^2)}$$

$$= \frac{30\ \text{Mpsi} \cdot 0.001\,\cancel{\text{in}}\,(1.25^2\,\cancel{\text{in}^2} - 0.5^2\,\cancel{\text{in}^2})(0.5^2\,\cancel{\text{in}^2} - 0)}{2\ 0.5^2\,\cancel{\text{in}^3}\,(1.25^2\,\cancel{\text{in}^2} - 0)}$$

$$= 0.0126\ \text{Mpsi} = 12{,}600\ \text{psi}$$

$\delta = 0.001$ in $\quad \mu_s = 0.6$

$r_o = \frac{2.5}{2} = 1.25$ in

$R = 0.5$ in

$r_i = 0$

$E = 30$ Mpsi

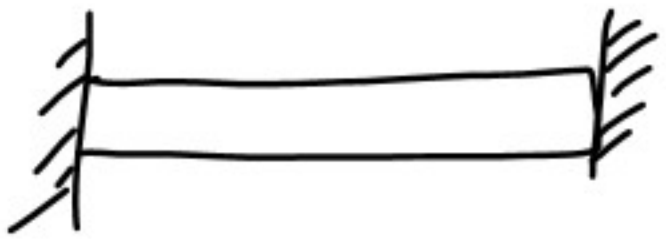
$C = \pi d = 3.14$ in

$A = 0.5\,C = 1.57\,\text{in}^2$

$p = \frac{F}{A} \Rightarrow \quad F = pA = 12600 \cdot 1.57 = 19{,}792$ lbs

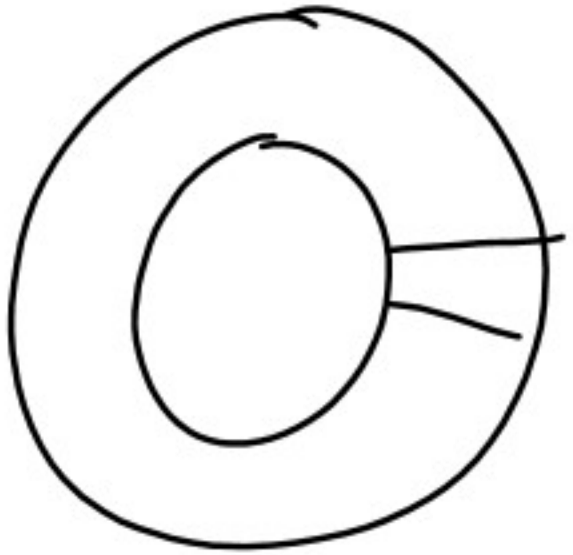
$f = N\mu_s \quad f = 19742 \cdot 0.6 = 11{,}875$ lbs

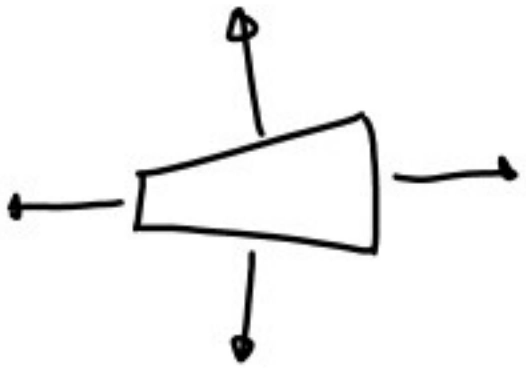
Temperature Effects



$$\varepsilon_x = \varepsilon_y = \varepsilon_z = \alpha \Delta t$$

$$\frac{\sigma}{\varepsilon} = E \Rightarrow \frac{\sigma}{E} = \varepsilon$$





$$\frac{\sigma}{E} = \alpha \Delta t$$

$$\varepsilon = \frac{\delta}{R} = \frac{0.001}{0.5} = 0.002$$

$$\varepsilon = \alpha \Delta t$$

$$0.002 = 6\times10^{-6}\ \frac{1}{{}^{\circ}F}\ \Delta t$$

$$\frac{0.002}{6\times10^{-6}}\ {}^{\circ}F = 333\,{}^{\circ}F$$