2.42 $D_o = 240$ mm $t = 10$ mm

$P_i = 2400$ kPa Find: τ_{max}.

$r_o = 120$ mm

$r_i = 110$ mm

$\tau = \dfrac{\sigma_t - \sigma_r}{2}$ evaluated @ $r = r_i$

$$= \frac{1}{2}\left(\frac{r_i^2 P_i}{r_o^2 - r_i^2}\left(1 + \frac{r_o^2}{r_i^2}\right) - \frac{r_i^2 P_i}{r_o^2 - r_i^2}\left(1 - \frac{r_o^2}{r_i^2}\right)\right)$$

$$= \frac{1}{\cancel{2}} \frac{\cancel{r_i^2} P_i}{r_o^2 - r_i^2}\left(\cancel{1} + \frac{r_o^2}{\cancel{r_i^2}} - \cancel{1} + \cancel{\frac{r_o^2}{r_i^2}}\right)$$

$$= \frac{P_i \, r_o^2}{r_o^2 - r_i^2} = \frac{(2.4 \times 10^6 \text{ Pa})(0.12^2 \text{ m}^2)}{(0.12^2 - 0.11^2)} = 15 \text{ MPa}$$

2.43 AISI 1020 cold-drawn steel tube.

ID : 1.25"
OD : 1.75"

Find $P_{o\,max}$ if $\sigma_{max} \le 80\%$ 57 Kpsi — TABLE A20

$\sigma_{max} \le 45.6$ Kpsi

let $P_i = 0$ evaluate @ $r = r_i$

$$\sigma_t = \frac{-P_o r_o^2 - \cancel{r_i^2} r_o^2 P_o / \cancel{r_i^2}}{r_o^2 - r_i^2}$$

$$\sigma_t = \frac{-2 P_o r_o^2}{r_o^2 - r_i^2} \qquad P_o = -\frac{\sigma_t (r_o^2 - r_i^2)}{2 r_o^2}$$

$$P_o = -\frac{(45.6 \times 10^3)\left(\left(\frac{1.75}{2}\right)^2 - \left(\frac{1.25}{2}\right)^2\right)}{2 \left(\frac{1.75}{2}\right)^2} = 11167 \text{ psi}$$

(2.48) Find max & min δ and P.

δ_{max} occurs with smallest hole, largest shaft.

δ_{min} occurs with largest hole, smallest shaft.

$$\delta = |\delta_i| + |\delta_o|$$

$$\delta_{max} = \frac{1}{2}(40.042 - 40.000) = 0.021 \text{ mm}$$

$$\delta_{min} = \frac{1}{2}(40.026 - 40.025) = 0.0005 \text{ mm}$$

use $R = 40$ mm

$$P = \frac{E\delta}{R}\left[\frac{(r_o^2 - R^2)(R^2 - r_i^2)}{2R^2(r_o^2 - r_i^2)}\right]$$

$E = 207$ GPa
$R = 20$ mm
$r_o = 40$ mm

if $r_i = 0$ $\quad P = \frac{E\delta}{2R}\left[\frac{r_o^2 - R^2}{r_o^2}\right]$

$$= \frac{(207)(0.021)}{2(20)}\left(\frac{40^2 - 20^2}{40^2}\right) = 8.15 \text{ MPa} - P_{max}$$

or

$$= \frac{(207)(0.0005)}{2(20)}\left(\frac{40^2 - 20^2}{40^2}\right) = 0.19 \text{ MPa} - P_{min}$$

2.49

$\delta_{max} = \frac{1}{2}(1.5016 - 1.5) = 0.0008$

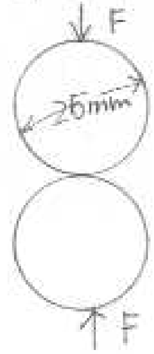
$\delta_{min} = \frac{1}{2}(1.5010 - 1.5010) = 0$

$E = 30$ Mpsi $\quad R = 0.75''$ $\quad r_o = 1.5''$

$$P = \frac{30\,(0.0008)}{2\,(1.5)}\left(\frac{1.5^2 - .75^2}{1.5^2}\right) = 6 \text{ kpsi} - P_{max}$$

0 psi $- P_{min}$

2.67 Given: 2 carbon steel balls.



Find: max value of principal stress, shear stress in MPa in terms of F.

sol: using Eq. 2-88

$$a = \sqrt[3]{\frac{3F}{8} \frac{(1-\nu_1^2)/E_1 + (1-\nu_2^2)/E_2}{1/d_1 + 1/d_2}}$$

here $\nu_1 = \nu_2$, $E_1 = E_2$, $d_1 = d_2$

$$\therefore a = \sqrt[3]{\frac{3}{8} F \frac{\cancel{2}(1-\nu^2)d}{\cancel{2}E}}$$

$$= \sqrt[3]{\frac{3}{8} F \frac{(1-\nu^2)d}{E}}$$

USE $\nu = 0.292$ $d = 25mm$, $E = 207 \times 10^3\ N/mm^2$ (Table A-3)

$$a = \sqrt[3]{\frac{3}{8} \frac{(1-0.292^2) \cdot 25\ mm}{207 \times 10^3\ N/mm^2}}$$

$$= 0.0346\ F^{1/3} \quad (mm/N^{1/3})$$

Eq (2-89)

$$P_{max} = \frac{3F}{2\pi a^2}$$

$$= \frac{3}{2\pi} F \times \frac{1}{(0.0346)^2 F^{2/3}}$$

$$= 398.8\ F^{1/3}$$

using Figure 2-33, the pricipal stresses can be found:

$$\sigma_z = 1\ P_{max} = 398.8\ F^{1/3}$$

$$\sigma_x = \sigma_y = 0.8\ P_{max} = 319\ F^{1/3}$$

$$\tau_{max} = 0.3\ P_{max} = 119.65\ F^{1/3}$$ — Ans.