$$W_Y = \sqrt{\left(\frac{1}{\sigma_n} W_{\sigma_{\theta\theta}}\right)^2 + \left(-\frac{\sigma_{\theta\theta}}{{\sigma_n}^2} W_{\sigma_n}\right)^2}$$

$$= \sqrt{\left(\frac{1}{6.5} * 1\right)^2 + \left(-\frac{-2}{6.5^2} * 0.2\right)^2} = 0.154137 = \pm 0.2$$

This is the theory calculation for hoop stress, $\sigma_{\theta\theta}$.

$$\sigma_{\theta\theta}(r = a) = \sigma_n(1 - 2\cos 2\theta)$$

$$= 6.5 * (1 - 2\cos(2 * 45)) = 6.5\ MPa$$

This is the theory calculation normalized hoop stress.

$$Y = \frac{\sigma_{\theta\theta}}{\sigma_n}$$

$$= \frac{6.5}{6.5} = 1$$

The location of the fringes at 90° was done with Paint to determine the radial distance of the fringes. The pixel distance was converted to meters using the proportion constant of the circular radius in meters divided by the measured pixel radius.

This is the calculation of the pixel conversion constants.

$$C_p = \frac{a}{P_r}$$

$$= \frac{0.0115}{223} = 0.000052\ \left({}^{m}/_{pixel}\right)$$

This is the uncertainty calculation for the pixel conversion constant.

$$W_{C_p} = \sqrt{\left(\frac{1}{P_r} W_a\right)^2 + \left(-\frac{a}{{P_r}^2} W_{aP_r}\right)^2}$$

$$= \sqrt{\left(\frac{1}{223} * 0.0001\right)^2 + \left(-\frac{0.0115}{223^2} * 5\right)^2}$$

$$= 0.000001 = \pm 1 * 10^{-6}\ \left({}^{m}/_{pixel}\right)$$