Theory and Equations

The fringe number, *N*, is given by,

$$\frac{h}{f_\sigma}(\sigma_I - \sigma_{II}) = N = 0,1,2,3, \dots \qquad (1)$$

where *N* is equal to the difference of the principle stresses multiplied by the specimens thickness, *h*, divided by the material constant, f_σ. The fringe number varies from zero to infinity in whole integers for an infinite specimen, with the corresponding stress of zero at the zero fringe and increase linearly to infinity.

A symmetric finite specimen load in uniaxial tension will have the principle stresses of, σ_I & σ_{II}, given by ~~equations 2 and 3,~~

$$\sigma_I = \frac{P}{wh} \qquad (2)$$

$$\sigma_{II} = 0 \qquad (3)$$

at the center of the center of the specimen. Viewed through polarizing films and illuminated by a monochromatic light source the fringes start to appear in the center of the specimen with the first fringe the zero fringe.

Apply equation 2 and 3 to equation 1 and rearranging the following relationship is given by,

$$\frac{Nf_\sigma}{h} = \sigma_I - \sigma_{II} = \frac{P}{wh} - 0 \qquad (4)$$

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where the principle stresses simplify down to the applied load, *P*, divided by the cross-sectional area of the dog bone specimen, found by the width, *w*, multiplied by thickness, *h*, of the dog bone specimen.

Rearranging equation 4 the load applied to the specimen is given by,

$$P = (f_\sigma w)N \qquad (5)$$

where the load is equal to the material constant, f_σ, multiplied by the width, *w*, and the fringe number, *N*.

The varying load, *P*, plotted versus the light intensity, *I*, that passes through the specimen, gives that plot of minima that correspond to the specific load, *P*, and the corresponding fringe number, *N*, shown by equation 5

The value of the material constant, f_σ, multiplied by the width, *w*, is the slope of equation 5 and it is given by,