True Strain Calculation

$$\epsilon = \ln\frac{L}{L_0} = \ln(1 - \frac{\delta}{L_0})$$

$$\therefore \epsilon_1 = \ln(1 - \frac{4.5067}{15.82}) = -0.33529$$

Similarly,

$$\epsilon_2 = -0.35539; \epsilon_3 = -0.37586$$

True Stress Calculation

$$\sigma = \frac{F}{A} = \frac{F}{A_0}\frac{A_0}{A}$$

Assuming volume conservation,

$$\sigma = \frac{F}{A_0}\frac{L}{L_0} = \frac{F}{A}(1 - \frac{\delta}{L_0})$$

$$\therefore \sigma_1 = \frac{-13228.3}{111.5903}(1 - \frac{4.5067}{15.82})\text{MPa} = -118.5434\text{MPa}$$

where the negative sign indicates compression

Similarly,

$$\sigma_2 = -119.916\text{MPa}; \sigma_3 = -121.237\text{MPa}$$

Friction Calculation

Let coefficient of friction be μ, then,

$$\mu = \frac{3(\frac{\sigma}{\sigma_{\text{avg}}}) - 1}{\frac{D}{h}}; \sigma_{\text{avg}} = \frac{\sigma_{\max}}{1+n}$$

$$|\sigma_{\max}| = 133.4320\text{MPa}$$

$$\sigma_{\text{avg}} = \frac{\sigma_{\max}}{1+n} = \frac{137.917}{1.218} = 109.5501\text{MPa}$$

$$\mu_{\text{final}} = \frac{3(\frac{133.432}{109.5501} - 1)}{\frac{13.8995}{8.32}} = 0.1304$$

General Expression,

$$\mu = \frac{3(\frac{\sigma}{109.5501} - 1)}{\frac{d}{h}}$$

The corresponding friction coefficient values have been tabulated in table 2.