Appendix A

Procedure for Calculating Cavity Expansion Pressure
(Yu and Houlsby's Model)

This procedure is abstracted from the paper by Yu and Houlsby.

(i) Calculate initial stress p_0 that is the pressure corresponding to the initial cavity with radius a_0.

(ii) For a given cavity pressure p, greater than initial yielding cavity pressure p1, calculate R from the following equation.

$$R = \frac{(m+\alpha)[Y+(\alpha-1)\cdot p]}{\alpha(1+m)[Y+(\alpha-1)\cdot p_0]}$$

$$where, \quad \text{m} = 1\,(\text{cylindrical cavity})\ \&\ 2\,(\text{spherical cavity}), \quad \alpha = \frac{1+\sin\phi}{1-\sin\phi}, \quad Y = \frac{2\cdot c\cdot\cos\phi}{1-\sin\phi}$$

(iii) Evaluate Λ_1 from the equation – only a few terms are sufficient.

$$\Lambda_1(x,y) = \sum_{n=0}^{\infty} A_n^1$$

$$where, \quad A_n^1 = \frac{y^n}{n!}\ln x, \quad if \;\; n=\gamma \qquad (\gamma = \frac{\alpha(\beta+m)}{m(\alpha-1)\beta}, \;\; \beta = \frac{1+\sin\psi}{1-\sin\psi})$$

$$A_n^1 = \frac{y^n}{n!\,(n-\gamma)}[x^{n-\gamma}-1], \quad otherwise$$

(iv) Evaluate a/a_0 from the following and from that the cavity pressure can be determined.

$$\frac{a}{a_0} = \{\frac{R^{-\gamma}}{(1-\delta)^{(\beta+m)/\beta} - (\gamma/\eta)\Lambda_1(R,\xi)}\}^{\beta/(\beta+m)}$$

$$where, \quad \delta = \frac{Y+(\alpha-1)p_0}{2(m+\alpha)G}, \qquad (G = \frac{E}{2(1+\nu)})$$

$$\eta = \exp\{\frac{(\beta+m)\cdot(1-2\nu)\cdot[Y+(\alpha-1)\cdot p_0]\cdot[1+(2-m)\cdot\nu]}{E\cdot(\alpha-1)\cdot\beta}\},$$

$$\xi = \frac{[1-\nu^2\cdot(2-m)]\cdot(1+m)\cdot\delta}{(1+\nu)\cdot(\alpha-1)\cdot\beta} \times [\alpha\cdot\beta + m\cdot(1-2\nu) + 2\nu - \frac{m\cdot\nu\cdot(\alpha+\beta)}{1-\nu\cdot(2-m)}]$$