This equation may be solved using the boundary condition of continuity of u at the elastic–plastic interface as given by Eq. (12). The resultant equation for displacement in the plastic region under pressure becomes:

$$\frac{u}{r} = \frac{\sigma_y}{E}\left[1.08(1-2\mu)\ln\frac{r}{\rho} + \frac{\rho^2(1-\mu) - b^2(1-2\mu) + (\rho^2 b^2)/(r^2)(2-\mu)}{\sqrt{(3b^4+\rho^4)}}\right]$$

Pressure-exterior Surface Strain

Graphs of exterior surface strain factor vs. pressure factor were obtained for all specimens tested. All curves for the same diameter ratio were averaged and are shown as the experimental curves in Fig. 9.

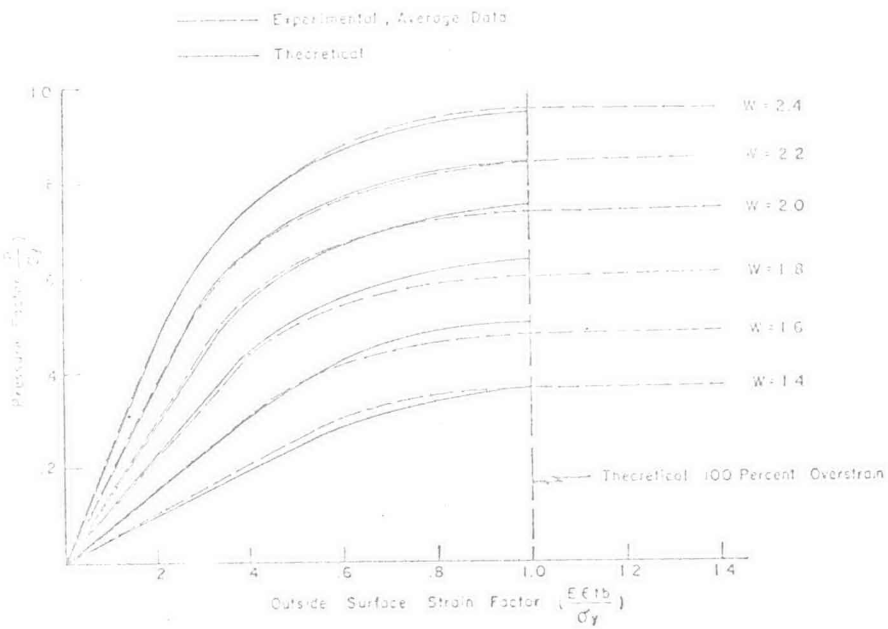

FIG. 9. Pressure factor vs. outside surface strain factor for various diameter ratios.

Since the radial stress at the bore ($r = a$) is equal to the internal pressure, the equation for P_ρ (pressure to produce plastic flow to a depth ρ) may be written from Eq. (16):

$$P\rho = \sigma_y\left[1.08\ln\frac{\rho}{a} + \frac{b^2-\rho^2}{\sqrt{(3b^4+\rho^4)}}\right] \qquad (22)$$

The expression for exterior-surface strain factor is obtained from Eq. (12) by substituting $r = b$

$$SF = \frac{\epsilon_{tb}E}{\sigma_y} = \frac{2\rho^2}{\sqrt{(3b^4+\rho^4)}} \qquad (23)$$

Solving Eq. (23) for ρ and substituting in Eq. (22) yields:

$$PF = \frac{1{\cdot}08}{4}\log\left(\frac{3SF^2W^4}{4-SF^2}\right) + \sqrt{\left(\frac{4-SF^2}{12}\right)} - \frac{SF}{2} \qquad (24)$$

The plots of this relationship are shown in Fig. 9 along with the experimental data. As can be seen, very close agreement was obtained between Eq. (24) and the experimental averages.

PERMANENT ENLARGEMENT RATIO

An important factor in the design of thick-wall cylinders using autofrettage is the ratio of the permanent enlargement at the bore to that at the outside

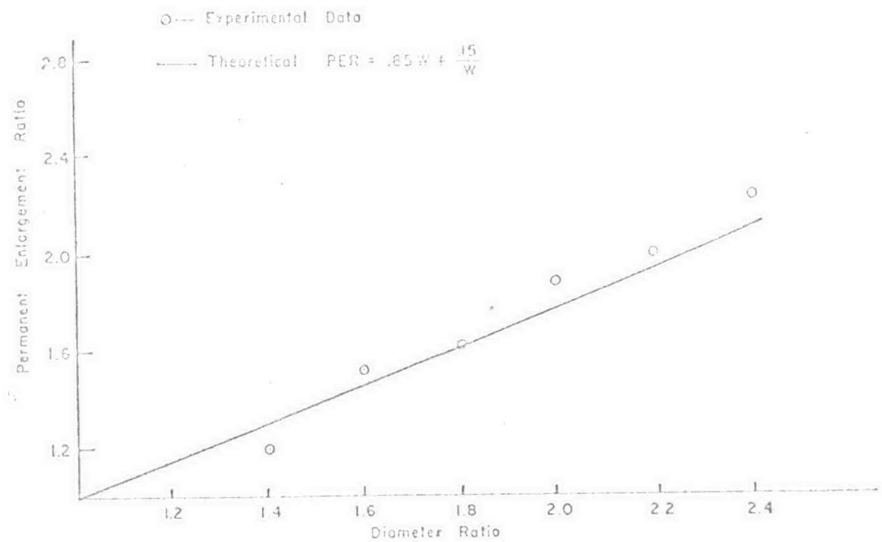

FIG. 10. Permanent enlargement ratio vs. diameter ratio.

surface. This ratio was obtained by physical measurements for all specimens tested. No correlation was found between permanent enlargement ratio and percent bore enlargement and therefore, all values for the same diameter ratio were average. These averaged values are shown as experimental points in Fig. 10.