the results obtained more closely approximated the open end than closed end condition.

Using Hookes' Law and the Lamé equations for elastic stresses in thick-walled cylinders, it can be shown that the slopes of the pressure—outside surface strain curve in the elastic region for the various end conditions are:

1. Closed end $$\frac{P}{\epsilon_{tb}} = \frac{W^2 - 1}{2 - \mu}$$

2. Open end $$\frac{P}{\epsilon_{tb}} = \frac{W^2 - 1}{2}$$

3. Restrained end $$\frac{P}{\epsilon_{tb}} = \frac{W^2 - 1}{2(1 - \mu^2)}$$

Figure 6 shows a plot of these equations plus a curve showing the average values obtained experimentally. From this figure it is seen that the physical condition encountered in this experimental program correlates closely with the open end condition.

Elastic Breakdown

The plot of internal pressure versus outside surface strain is linear up to initial yield or elastic breakdown at the bore. The experimental values for the elastic breakdown pressure were averaged for each diameter ratio and plotted in Fig. 7 as a function of pressure factor vs. diameter ratio. For

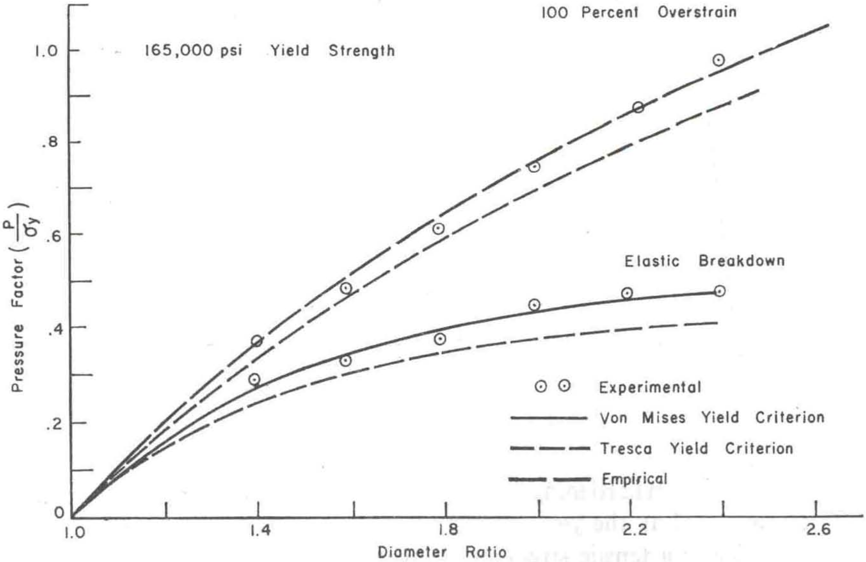

FIG. 7. Elastic breakdown and 100 percent overstrain pressure factor vs. diameter ratio.

comparison, the theoretical elastic breakdown pressure factor, based on the von Mises and Tresca yield criteria for the open end condition, are also shown. Based on the von Mises yield criterion and assuming $\sigma_z = 0$, elastic breakdown occurs when:

$$PF = \frac{W^2 - 1}{\sqrt{(3W^4 + 1)}} \tag{1}$$

From the Tresca yield criterion elastic breakdown is:

$$PF = \frac{W^2 - 1}{2W^2} \tag{2}$$

As can be seen from the figure, there is close correlation between the experimentally determined and the theoretical von Mises elastic breakdown condition.

100 *Percent Overstrain*

When the internal pressure exceeds the elastic breakdown pressure, the elastic-plastic interface moves from the bore towards the outside diameter. This movement is a function of the internal pressure, yield strength, diameter

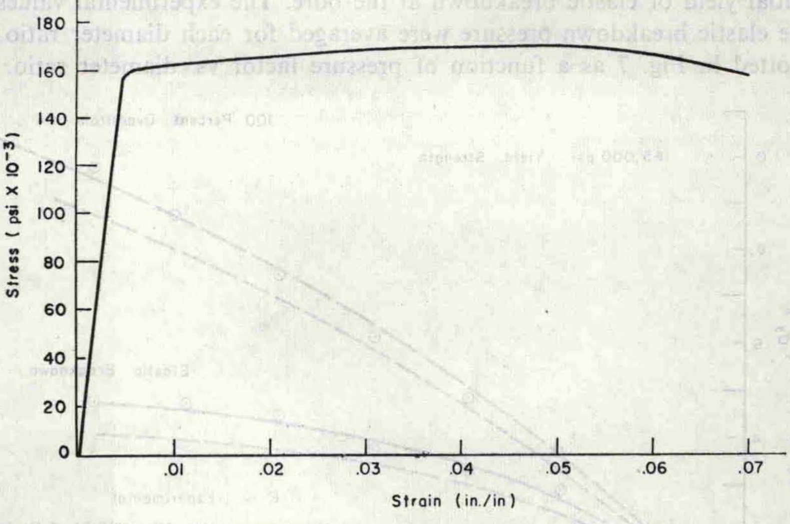

FIG. 8. Stress–strain diagram.

ratio and the strain hardening capabilities of the material. The strain hardening of this material at the yield-strength level considered is small, as shown in Fig. 8 which is a tensile stress-strain diagram for the material used in this program. As can be seen from the figure, for purposes of calculation and