Apparatus

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OVERSTRAIN OF HIGH-STRENGTH C[illegible]ND CYLINDERS O[illegible] INTERMEDIATE DIAME[illegible] RATIO

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Abstract—Those associated with the pressure vessel [illegible] have long been interested in means for increasing the elastic load carrying capaci[illegible] thick-wall cylinders. Over the years, such techniques as wire wrapping, bore quenching and the more common jacketing and autofrettage have been utilized.

Recent requirements in the pressure vessel and weapons fields now make it necessary to consider means for even further increasing the elastic load carrying capacity of cylinders fabricated from high-strength materials. This paper describes the results of an experimental program associated with the application of the autofrettage principle to materials in the 160,000–190,000 psi yield strength level and diameter ratio range of 1.4–2.4.

Data are presented for the elastic breakdown and full overstrain pressure as a function of diameter ratio and compared to that theoretically predicted based on the Tresca and von Mises yield criteria.

Data are also presented for the permanent enlargement and enlargement ratio associated with the complete overstrain condition.

Also presented is a system of simplified equations for the stresses and strains in both the elastic and plastic regions of an overstrained open-end cylinder. These equations are based on an approximation of the von Mises yield criterion and show very good agreement with the experimental results.

LIST OF [illegible]BOLS

P = pressure
ϵ = unit strain
σ = stress
σ_y = yield stress
r = variable radius
a = inside radius
b = outside radius
ρ = radius of elastic–plastic interface
W = diameter ratio, b/a
μ = Poisson's ratio
E = Young's modulus of elasticity
PF = pressure factor, P/σ_y
SF = strain factor, $\epsilon E/\sigma_y$

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