Referenca?
(No accession number)



# Creep of Thick-Walled Cylinders Based on Torsion Creep Data for 0.18 Percent Carbon Steel at 400° C

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## ABSTRACT

The possible advantages of using torsion creep data in preference to constant load tension creep data in the analysis of cylinders creeping under a constant internal pressure are considered. Presented is a résumé of the various theories that have been proposed including a modified Bailey solution that allows for wall thinning.

Experimental creep data for torsion, constant load tension, and pressure tests on thick-walled cylinders are presented. The various theories proposed have been computed, and the theoretical curves are compared with the experimental data.

It is concluded that torsion creep data are of a more fundamental nature than constant load tension data where the stress is varying. From the observation that axial creep in cylinders is negligibly small, it is concluded that shear creep data is of greater relevance in cylinder analysis than constant load tension creep data. It is also concluded that for the magnitude of creep strains involved in this experimental work due account must be taken of the effect of wall thinning of a thick-walled cylinder subjected to creep. The most consistent agreement between theory and experiment was obtained using isochronous shear stress-strain data.

## NOMENCLATURE

| | |
|---|---|
| $\sigma_\theta, \sigma_r, \sigma_z$ | circumferential, radial, and axial stresses |
| $\sigma'_r, \sigma'_\theta, \sigma'_z$ | circumferential, radial, and axial stress deviations |
| $\epsilon_\theta, \epsilon_r, \epsilon_z$ | corresponding strains |
| $\dot{\epsilon}_\theta, \dot{\epsilon}_r, \dot{\epsilon}_z$ | corresponding strain rates |
| $\tau$ | shear stress |
| $\gamma$ | shear strain |
| $p$ | internal pressure |
| $t$ | time |
| B | material constant |
| $n$ | stress index |
| $m$ | time index |
| $J_2$ | second stress invariant $\left(= \frac{1}{6} \left\{\Sigma(\sigma_1 - \sigma_2)^2\right\}\right)$ |
| $r$ | radius |
| $a$ | initial inside radius |
| $b$ | initial outside radius |
| $K$ | diameter ratio $(= b/a)$ |
| $E$ | Young's modulus |
| $\mu$ | Poisson's ratio |

## INTRODUCTION

There is a considerable amount of evidence to support the use of torsion creep data in preference to the conventional constant load tension creep data