

Results

A large number of torsion specimens have been tested mainly at 20, 160, 300 and 370°C, though a few specimens of EN3 were also tested at 90 and 230°C. In order to keep down the number of graphs the curves of the ratio of torque to the section modulus against shear strain at the outer surface have been plotted and envelope curves drawn, though it should be noted that all the experimental points for a given test lay reasonably on a smooth curve. The shear stress-strain curves were then derived using the method ascribed to Nadai and fully described for instance by Crossland (1964, 1965). These derived curves alone are given here to reduce the number of graphs. Figures 7 and 8 are the curves at small and large strains for Hykro at various temperatures; similarly curves in Figures 9 and 10 are for Vibrac and curves in Figures 11 and 12 are for EN3.

In the Nadai construction for deriving shear stress-strain data from torque-twist measurements from a torsion test on solid specimens it is assumed that the material is homogeneous. However, if the material is strain rate dependent then it is effectively non-homogeneous as the strain rate will vary with radius. In order to investigate if the assumption of homogeneity was justified, especially at elevated temperatures, some torsion tests on tubes and solid specimens of Hykro and Vibrac were carried out, to establish if the same shear stress-strain curve was obtained with tubes as could be deduced from solid specimens. Tests at 300°C indicated satisfactory agreement.

Relaxation tests in which an increment of strain was applied and the torque was then measured at various intervals of elapsed time were also carried out to get some indication of time-dependent effects. The difference in the torque-twist curves after intervals of 3, 10 and 30 min were established up to temperatures of 370°C for Hykro and Vibrac and up to 230°C for EN3. The differences were negligibly small except at 370°C for Vibrac where there was a more significant difference in the three curves at 3, 10 and 30 min, though probably the errors in using the Nadai construction were still not unacceptably large.

The number of tension tests carried out was less than with torsion as the furnace could not be satisfactorily used below 160°C, and the strains which could be recorded were limited by the extensometer as it had to be removed at relatively small strains.

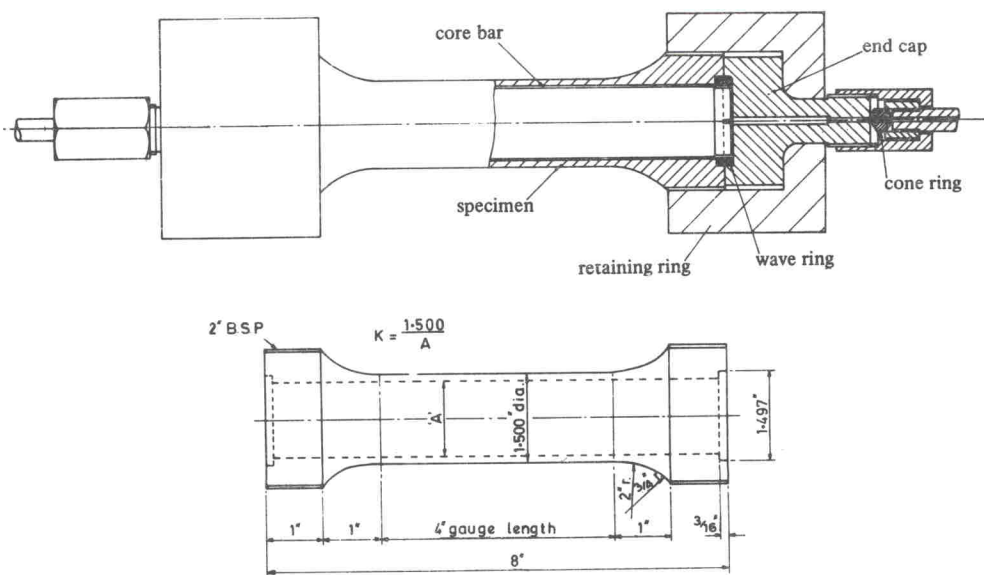


Figure 6. Detail of cylinder assembly.

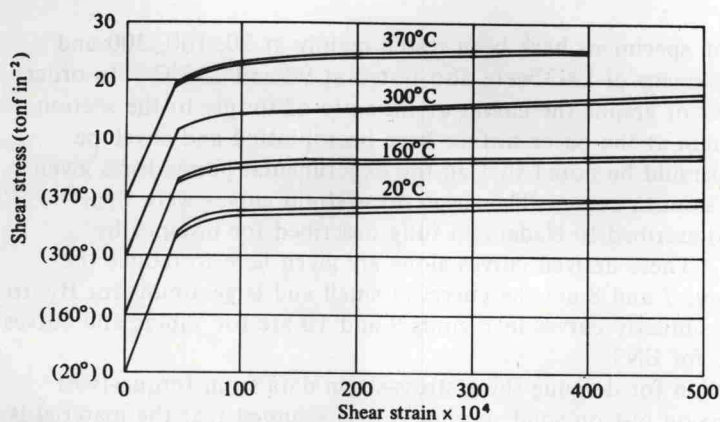


Figure 7. Derived shear stress-strain curves at small strains for Hykro.

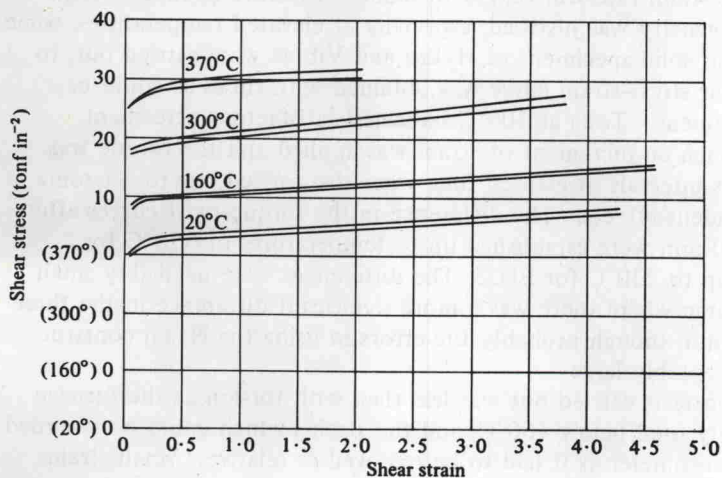


Figure 8. Derived shear stress-strain curves at large strains for Hykro.

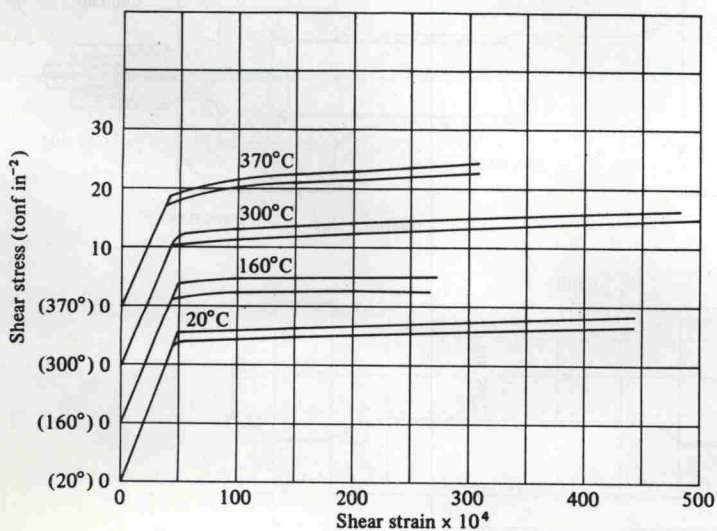


Figure 9. Derived shear stress-strain curves at small strains for Vibrac.