ing temperature over a wide range of temperatures below the glass transition temperature.

In this investigation an attempt has been made to link together the two approaches to yield outlined above. The tensile and compressive yield stresses of poly(methylmethacrylate) have been measured over a range of temperatures and strain-rates. It was found that the compressive yield stress was more sensitive to strain-rate than the tensile yield stress. The theory for yielding of isotropic glassy polymers proposed by Robertson [13] has been modified to allow for the effect of hydrostatic pressure. Using this modified theory it has been possible to correlate quantitatively the tensile and compression data from this investigation with the data obtained on the same material in torsion tests under an overall hydrostatic pressure [14].

The tensile yield stress of isotropic amorphous poly(ethylene terephthalate) sheet has also been measured over a wide range of temperatures and strain-rates and fitted to the above theory using parameters deduced from the literature.

2. Experimental

The poly(methylmethacrylate) (PMMA) tensile and compression specimens were machined out of 1 in. (2.54 cm) thick sheets of ICI "Perspex". The tensile specimens were approximately 4.3 mm in diameter with a straight gauge length of 2.5 cm. Compression specimens were circular cylinders with a diameter of 6.4 mm and length of 12.8 cm.

The poly(ethylene terephthalate) (PET) was supplied by ICI Plastics Ltd with a thickness of approximately 0.64 mm. The optical birefringence of the material was measured as less than 5×10^{-5} and the yield stress in the plane of the sheet was found to be isotropic within experimental error. The tensile specimens were dumbbell shaped with a straight gauge length of 2.5 cm width 4 mm.

All tests were performed on an Instron tensile testing machine, inside an environmental chamber within which the temperature could be controlled to within $\pm 0.5^\circ$ C both above and below room temperature. Tensile tests over a wide range of strain-rates were performed on PMMA at 60 and 90° C and on PET at − 25, 20, 40, 50 and 60° C. A minimum of 20 min was allowed for each specimen to reach thermal equilibrium. Compression tests on PMMA were conducted at room temperature, both in direct compression between the machine crosshead and a compression type load cell, and also using a compression cage in conjunction with a tensile load cell.

True yield stresses were obtained by relating the maximum observed load to current cross-sectional area. A correction to all measurements was made to allow for deformation of the machine and compression cage.

3. Results

The results obtained are shown graphically in figs. 1 and 2. Fig. 1 represents the variation of tensile and compressive yield stresses of PMMA with $\log_{10}$ (strain-rate) at various temperatures. In order for easy comparison to be made between tension, compression and torsion data and also with the Robertson theory, the shear component of the yield stress is plotted as the ordinate and $\log_{10}$ (shear strain-rate) as the abscissa. In fig. 2 the results obtained for the tensile yield of PET at − 25, 20, 40, 50 and 60° C are plotted as the tensile component of stress versus $\log_{10}$ (tensile strain-rate).

Fig. 3 is taken from Rabinowitz *et al* [14] and represents the variation of torsional yield stress of PMMA at constant (room) temperature and shear strain-rate (4×10^{-4} sec^{-1}) with superposed hydrostatic pressure. (The material used was identical to that used in the current investigation.)

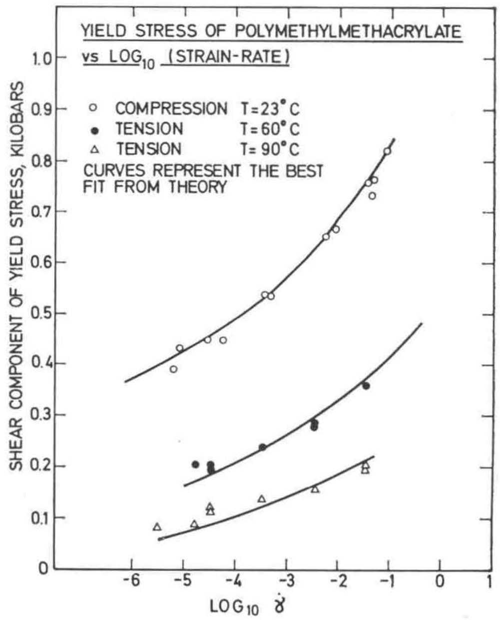

Figure 1 The variation of tensile and compressive yield stresses with strain-rate and temperature, PMMA.