

Table 3 Example of Load Dependence Data

| Pressure (MPa) | %Modulus Change C_{33} | | | | | | | %Modulus Change C_{44} | | | | | | |
|----------------|--------------------------|-------|-------|-------|----------|-------------|-------------|--------------------------|-------|-------|-------|----------|-------------|-------------|
| | XXX_a | XXX_b | XXX_c | Avg. | St. Dev. | Avg. + Std. | Avg. - Std. | XXX_a | XXX_b | XXX_c | Avg. | St. Dev. | Avg. + Std. | Avg. - Std. |
| 5.374 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 5.288 | 0.61 | 0.92 | 0.31 | 0.61 | 0.31 | 0.92 | 0.30 | -0.22 | -0.45 | 0.68 | 0.00 | 0.60 | 0.60 | -0.60 |
| 4.003 | 0.00 | -0.30 | 0.61 | 0.10 | 0.47 | 0.57 | -0.36 | -0.22 | -0.90 | 0.68 | -0.15 | 0.79 | 0.64 | -0.94 |
| 2.976 | -0.30 | -0.30 | -1.80 | -0.80 | 0.87 | 0.06 | -1.67 | -0.90 | -0.67 | -0.22 | -0.60 | 0.34 | -0.26 | -0.94 |
| 1.778 | -1.20 | -0.60 | -0.61 | -0.80 | 0.34 | -0.46 | -1.15 | -1.34 | -1.78 | -0.45 | -1.19 | 0.68 | -0.51 | -1.87 |
| 1.193 | -1.50 | -2.09 | -3.27 | -2.29 | 0.90 | -1.39 | -3.19 | -2.22 | -2.22 | -0.67 | -1.70 | 0.89 | -0.81 | -2.59 |
| 0.625 | -4.12 | -4.41 | -4.42 | -4.31 | 0.17 | -4.14 | -4.49 | -2.43 | -2.87 | -1.55 | -2.28 | 0.67 | -1.61 | -2.96 |

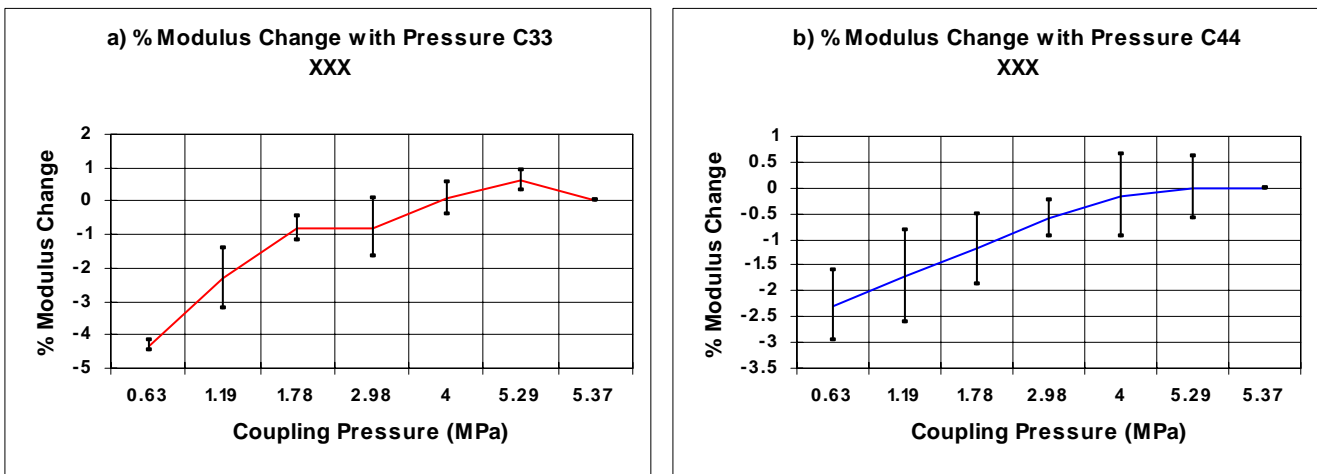


Figure 2 Graphs of the average change in modulus as a function of coupling pressure for C_{33} and C_{44}

The load sensitivity of the C_{33} and C_{44} elastic constants are plotted in Figure 2a and 2b and presented in tabular form in Table 3 for the Type 4 material. The load dependence of the through-the-thickness modes (V_{33} and V_{32}) are measured by monitoring the variation in ultrasonic transit time as the load is applied. Many friction materials exhibit load-dependent modulus in the thickness direction. Variation in modulus over the coupling pressure range from 0.6 MPa to 5 MPa of over 4 percent has been observed.

The XXX material would be classified as having minimal load dependence for both the shear and longitudinal modulus. The data in Figure 2 show the % variation in modulus from the maximum value measured at the highest load. The plotted points are the average values obtained from three samples and the error bars are the standard deviations. Two features should be noted: 1) modulus generally increases with increasing load and 2) measurement variability increases with decreasing load. For both the shear wave measurements, C_{44} and longitudinal measurements, C_{33} , there is some evidence of a plateau at the higher loads.