

## **Comparison of Experimental Techniques for Determination of Viscoelastic Material Properties**

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Viscoelastic materials are time dependent and have memory effects that alter the present response of the material to an applied load. As a result, any experimental technique must collect data over a range of frequencies or time periods. Further, two behaviours are of particular interest: stress relaxation and creep. Current American Society for Testing and Materials standards for viscoelastic materials include dynamic mechanical analyzers (DMA) and creep tests. DMA techniques are frequency domain based, while creep tests are in the time domain. For viscoelastic structures, the material property of most interest is the stress relaxation modulus which cannot be determined directly by either method. Instead, the DMA returns a complex modulus which must be transformed to the stress relaxation modulus via Fourier transforms. The creep tests return the creep compliance modulus which is related to the stress relaxation modulus via an expression in the Laplace transform domain.

This presentation will describe these methods and the direct measurement of stress relaxation via a custom built stress relaxation rig. The experimental methods, and associated data processing techniques in MATLAB, will be elaborated with particular emphasis on error propagation and variations in the resulting Prony series that are used to describe stress relaxation. Results acquired from testing polymethyl methacrylate (PMMA) will be shown to illustrate the impact of experiment and data processing selection on the resulting Prony series.