In 1935, Andrew Gemant conceived of the complex viscosity, a rheological material function measured by "jiggling" an elastic liquid in oscillatory shear [Rheol. Acta, 51, 481 (2012)]. This test reveals information about both the viscous and elastic properties of the liquid, and about how these properties depend on frequency. The test gained popularity with chemists when John Ferry perfected instruments for measuring both the real and imaginary parts of the complex viscosity ['Ferry 1912-2002 …,’ Mem. Trib., NAE, 17, 96 (2013)]. In 1958, Cox and Merz discovered that the steady shear viscosity curve was easily deduced from the magnitude of the complex viscosity, and today small-amplitude oscillatory shear is the single most popular rheological property measurement.

With oscillatory shear, we can control two things: the frequency (Deborah number) and the shear rate amplitude (Weissenberg number). When the shear rate amplitude is large, the elastic liquids respond with a shear stress over a series of odd-multiples of the test frequency. In this lecture we will explore how this shear stress response is measured, and we will examine both continuum (corotational models [JNNFM, 166, 1081 (2011)]) and molecular (rigid dumbbells) approaches to interpreting large-amplitude oscillatory shear measurements. We consider these models to be the simplest relevant continuum and molecular models. We will also explore the normal stress response [Rheol. Acta, 50, 741 (2011)], and the fluid temperature rise [I&ECR, 52, 2008 (2013)] in large-amplitude oscillatory shear flow.