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Extracting Strength from Ramp-Release Experiments on Z[1]

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Releasing from a compressed state has long been recognized as a sensitive measure of a material's constitutive response. The initial elastic unloading provides insights which can be related to changes in shear stress or, in the context of classic plasticity, to the material's yield surface. Ramp compression and subsequent release experiments on Sandia's Z machine typically consist of a driving aluminum electrode pushing a sample material which is backed by a window. A particle velocity measurement of the sample/window interface provides a ramp-release profile. Under most circumstances, however, the impedance mismatch at this interface results in the measurement of a highly perturbed velocity, particularly at the late times of interest. Wave attenuation, the finite pressure range over which the material elastically unloads, and rate effects additionally complicate the interpretation of the experiment. In an effort to accurately analyze experiments of this type, each of these complications is addressed. The wave interactions are accounted for through the so-called transfer function methodology and involves a coupling of the experimental measurements with numerical simulations. Simulated window velocity measurements are combined with the corresponding *in situ* simulations to define a mapping describing the wave interactions due to the presence of the window. Applying this mapping to the experimentally measured velocity results in an *in situ* sample response which may then be used in a classic Lagrangian analysis from which the strength can be extracted via the self-consistent method. Corrections for attenuation, pressure averaging, and limitations of the analysis due to rate-effects are verified through the use of synthetic data. To date, results on the strength of aluminum to 1.2MBar, beryllium to 1 MBar, and tantalum to over 2MBar have been obtained through this methodology and will be presented.

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