Novel measurements of shock pressure decay in PMMA using detonator loading

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Los Alamos National Laboratory — An empirical model equation for shock pressure decay in PMMA was determined through a unique set of experiments employing detonator loading. Custom polymethyl methacrylate (PMMA) witness blocks were designed with monolithic architecture to house precise PMMA gap thicknesses ranging from 0-10 mm in 1 mm increments. The PMMA gaps separated detonator working surfaces from windowed photonic Doppler velocimetry (PDV) probes, and were designed to provide undistorted optical access to ultra-high-speed framing and digital streak cameras. The shock wave image framing technique (SWIFT), and a new laser-backlit digital streak diagnostic, simultaneously captured the temporal evolution of detonator-induced diverging shock waves within the PMMA gaps. The PDV diagnostic measured critical mass velocity histories as the shocks exited the variable gap thicknesses. The multi-diagnostic data package was used to characterize the shock pressure decay in PMMA as a function of shock propagation time and PMMA thickness.