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Determining the Shock Hugoniot of Transparent Materials with Hydrodynamic Pressure Loading FORREST SVINGALA, GARY SETTLES, Penn State Gas Dynamics Lab — The shock Hugoniot is a fundamental relationship between pressure, volume, and energy for a given material. Accurate knowledge of the Hugoniot for a material is critical in order to determine its response to blast waves and ballistic impacts. Traditionally, the shock Hugoniot is measured on a point-by-point basis through an extensive series of high-velocity impact experiments. Observations are confined to pointwise pressure or velocity measurements at the free surfaces of the sample. In this work a new technique is presented, one which allows multiple points of the shock Hugoniot to be determined in a single experiment. A gram-scale explosive charge is detonated to produce an unsteady shock wave in the transparent material sample. Pressure between the charge and sample is initially high, but is rapidly reduced by expansion of the explosive product gases. This loading produces an initially strong shock wave, which attenuates to near the bulk sound speed as it transits the sample. Using a high-speed shadowgraph technique, multiple shock and particle velocity combinations are observed in a single experiment. This allows the measurement of a shock Hugoniot in fewer experiments than by traditional methods. This technique produces data in agreement with published Hugoniot results for polyurethane. It can be easily extended to measure the Hugoniot of any transparent solid, liquid, or gas.

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