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Shock Tube Investigation of Quasi-Steady Drag in Shock-Particle Interactions JUSTIN WAGNER, STEVEN BERESH, SEAN KEARNEY, BRIAN PRUETT, ELTON WRIGHT, Sandia National Laboratories — A reassessment of historical drag coefficient data for spherical particles accelerated in shock-induced flows has motivated new shock tube experiments of particle response to the passage of a normal shock wave. Particle drag coefficients were measured by tracking the trajectories of 1-mm spheres in the flow induced by incident shocks at Mach numbers 1.68, 1.93, and 2.04, over test times of about 0.5 milliseconds. Previous shock tube studies conducted under similar test conditions have concluded that the unsteadiness associated with the accelerating particle resulted in elevated drag coefficients. However, recent theoretical work suggests that such effects should only last for microsecond timescales. Furthermore, low values for the acceleration parameter indicate that unsteadiness should be negligible. Consistent with past experiments, the current data clearly show that as the Mach number increases, the drag coefficient increases substantially. This increase significantly exceeds the drag predicted by incompressible standard drag models, but a recently developed compressible drag correlation returns values quite close to the current measurements. Consistent with recent theoretical work, these observations suggest that elevated particle drag coefficients are a quasi-steady phenomenon attributed to increased compressibility rather than true flow unsteadiness.

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