Abstract Submitted
for the DFD12 Meeting of
The American Physical Society

The Breakup of Water Cylinders Behind Normal Shocks J.C. MENG, T. COLONIUS, California Institute of Technology — We simulate the drift and breakup of a water cylinder in the flow behind a normal shock. The unsteady Euler equations, closed using the stiffened-gas equation of state, are solved with a compressible, multicomponent, shock- and interface-capturing algorithm. The effects of surface tension and viscosity are negligible at early times compared to the larger shear forces. Computed drift velocities are in good agreement with experiments. For the high- speed flow regimes considered, the breakup mode is stripping. Pressure gradients arise on the cylinder's surface causing it to deform laterally. As the cylinder is flattened, sheets of liquid are drawn off the periphery and break up further downstream. Unsteady vortex shedding is observed in the wake of the disintegrating cylinder. As the shock Mach number is increased, higher airflow velocities result in faster breakup and greater cylinder accelerations. These accelerations are subject to fluctuations that grow with shock strength. Qualitative features of the flow are compared to images from experiments on cylinders and drops.

Jomela Meng
California Institute of Technology

Date submitted: 08 Aug 2012 Electronic form version 1.4