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Laser-Induced Fluorescence Imaging of Droplet Vaporization and Fuel Dispersion in Supersonic Flow[1] Y.J. KIM, R.G. CERFF, J.C. HERMANSON, University of Washington — The disruption of simulated fuel droplets in supersonic flow is examined experimentally in a draw-down wind tunnel. Monodisperse 100 μm diameter fluid droplets of 2-propanol and a 50/50 by volume hexanol/pentane (Hex-Pen) mixture are generated upstream of the tunnel entrance. The Hex-Pen droplets potentially become superheated as the local static pressure drops below the vapor pressure. The droplets achieve supersonic velocities relative to the surrounding air, a relative Mach number as high as 1.8 and Weber numbers as high as 300. Laser-Induced Fluorescence imaging of the disrupting droplets and the expelled vapor was performed with a pulsed 266 nm Nd:YAG laser. Droplets containing 5% acetone were illuminated by a laser light volume sufficient to capture the entire disrupting droplet. The dispersion of the expelled vapor indicates that Hex-Pen droplets evaporate more rapidly with downstream distance than the non-volatile 2-propanol droplets. The degree to which the vaporization rate for the Hex-Pen droplets exceeds that of the 2-propanol droplets increases at the point downstream of throat where superheating appears to commence.

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