

**Disruption and Vaporization of Simulated Fuel Droplets under Locally  
Supersonic Conditions****Dr. James C. Hermanson**Department of Aeronautics and Astronautics  
University of Washington**Thursday, March 7, 2013 -- 3:30pm -- Guggenheim (G442)****Abstract:**

The disruption of droplets under supersonic conditions was studied in a draw-down supersonic wind tunnel. The test liquids included 2-propanol, tetraethylene glycol dimethyl ether, and a hexanol-pentane 50/50 mixture by volume. The hexanol-pentane mixture has similar physical properties to 2-propanol, but a considerably higher vapor pressure. The droplets were accelerated in the supersonic flow, achieving supersonic velocities relative to the surrounding air. The droplets reached a relative Mach number of as high as 1.8 and Weber numbers of 320. The droplets were imaged by direct close-up single- and multiple-exposure imaging and by Laser-Induced Fluorescence (LIF) imaging. The low static pressure in the supersonic stream had the potential to give rise to superheating of the droplet fluid as the local static pressure became significantly lower than the vapor pressure of the droplet liquid, depending on the test liquid employed. Droplet lifetimes for the more volatile hexanol/pentane mixture appeared to be shorter due to accelerated vaporization consistent with superheating, though little impact was observed on the droplet velocity and relative Mach number. LIF imaging of the expelled vapor indicated that the more volatile liquid droplets had a higher vaporization rate than non-volatile droplets at all downstream locations, suggesting that droplet superheating does play some role in accelerating the vaporization of supersonic droplets under these conditions.

**Bio:**

Professor James C. Hermanson received a Bachelor of Science in Aeronautics & Astronautics from the University of Washington in 1977. Subsequently he was an Engineer with Boeing Aerospace Company. He performed his graduate studies at the California Institute of Technology, earning a Master of Science in 1980 and a Ph.D. in 1985, both in Aeronautics. Dr. Hermanson was a Post-doctoral Fellow at the Institut für Physikalische Chemie at the Universität Göttingen, in Göttingen, Germany. Other professional experience includes the Boeing Aerospace Company in Kent, WA, United Technologies Research Center in East Hartford, CT. and Worcester Polytechnic Institute in Worcester, MA. Professor Hermanson has been with the Department of Aeronautics & Astronautics at the University of Washington since 2002, where he holds the rank of Professor and currently serves as the Chair of the Department.

Professor Hermanson and his research groups are known for their work in compressible flow, combustion and two-phase flows. His research in compressible flow has involved the study of the penetration and structure of gas-phase and supercritical-fluid transverse jets in supersonic flow, the instability and mixing associated with shock wave passage through turbulent vortex rings and jets, fuel droplet disruption in supersonic flow, and mixing enhancement in compressible flow by lobed mixers. His work in combustion has included turbulent shear layer mixing and combustion, the stability and emissions of premixed and partially premixed turbulent flames, and the turbulent structure and emissions of strongly-pulsed, turbulent jet diffusion flames in normal- and microgravity. Multi-phase flow research conducted by Prof. Hermanson's group has examined condensing and evaporation films and the development of ultrasound diagnostics for film thickness measurement.

Professor Hermanson is a Fellow of the American Society of Mechanical Engineers and an Associate Fellow of the American Institute of Aeronautics and Astronautics. Hermanson also served as Associate Editor of the *AIAA Journal* from 1998 to 2002. In 2004 Dr. Hermanson received a best paper award for his work in microgravity combustion of pulsed, turbulent jet diffusion flames. He was holder of the George I. Alden Chair in Engineering at WPI from 1999-2002 and received an NSF CAREER Award in 1998. Hermanson is the author or co-author of more than 100 publications and conference papers.

