

## Swirl Coaxial Injector Testing with LOX/RP-1

Sandra Elam Greene

Matt Casiano

Testing was conducted at NASA's Marshall Space Flight Center (MSFC) in the fall of 2012 to evaluate the operation and performance of liquid oxygen (LOX) and kerosene (RP-1) in an existing swirl coaxial injector. While selected Russian engines use variations of swirl coaxial injectors, component level performance data has not been readily available, and all previously documented component testing at MSFC with LOX/RP-1 had been performed using a variety of impinging injector designs. Impinging injectors have been adequate for specific LOX/RP-1 engine applications, yet swirl coaxial injectors offer easier fabrication efforts, providing cost and schedule savings for hardware development. Swirl coaxial elements also offer more flexibility for design changes. Furthermore, testing with LOX and liquid methane propellants at MSFC showed that a swirl coaxial injector offered improved performance compared to an impinging injector. So, technical interest was generated to see if similar performance gains could be achieved with LOX/RP-1 using a swirl coaxial injector. Results would allow such injectors to be considered for future engine concepts that require LOX/RP-1 propellants. Existing injector and chamber hardware was used in the test assemblies. The injector had been tested in previous programs at MSFC using LOX/methane and LOX/hydrogen propellants. Minor modifications were made to the injector to accommodate the required LOX/RP-1 flows. Mainstage tests were performed over a range of chamber pressures and mixture ratios. Additional testing included detonated "bombs" for stability data. Test results suggested characteristic velocity,  $C^*$ , efficiencies for the injector were 95-97%. The injector also appeared dynamically stable with quick recovery from the pressure perturbations generated in the bomb tests.