

SPACE TRANSPORTATION SOLUTIONS AND INNOVATIONS SYMPOSIUM (D2)  
Upper Stages, Space Transfer, Entry and Landing Systems (3)

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## PROGRESS IN DEVELOPING A LOX/METHANE NANOSATELLITE LAUNCH VEHICLE

**Abstract**

As space mission planners look to disaggregation to control costs, a need is emerging for a dedicated small launch vehicle that can affordably launch time critical or orbit-specific small payloads. To address this need, Aerojet Rocketdyne has recently undertaken the development of components and systems for an innovative low-cost LOX/methane nanosatellite launch vehicle. Conceptual design studies have been completed on a two stage to orbit launch vehicle capable of placing a 10 kg payload into sun synchronous orbit (SSO) and a derivative three stage vehicle with 100 kg SSO capability. System simplicity is achieved by using common avionics on all stages and by structurally integrating the pressurization system with the propellant tanks. The pressure-fed stages use helium-based tridyne for many system functions including tank pressurization and upper stage roll control. Proof of concept hardware fabrication and testing activities have been successfully completed. Primary development focus has been on the fabrication, assembly and testing of the vehicle upper stage. The upper stage has undergone proof pressure testing, functional check-out and engine gimbal testing. Additionally, the tridyne roll control thrusters have completed hot-fire demonstration testing. Hot-fire testing of the regeneratively-cooled first stage engine thrust chamber assembly was also successfully accomplished. A flight test program has been developed for the upper stage using a balloon launch to flight qualify the stage and demonstrate the capability of the upper stage as a sounding rocket.