

Soldier-Warfighter Operationally Responsive Deployer for Space

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Sponsoring Program(s)

Space Technology Mission Directorate
Game Changing Development
Human Exploration and Operations Mission Directorate
Advanced Exploration Systems

Project Description

The Soldier-Warfighter Operationally Responsive Deployer for Space (SWORDS) project was a joint project between the U.S. Army Space & Missile Defense Command (SMDC) and NASA. The effort, lead by SMDC, was intended to develop a three-stage liquid bipropellant (liquid oxygen/liquid methane), pressure-fed launch vehicle capable of inserting a payload of at least 25 kg to a 750-km circular orbit. The vehicle design was driven by low cost instead of high performance. SWORDS leveraged commercial industry standards to utilize standard hardware and technologies over customized unique aerospace designs. SWORDS identified broadly based global industries that have achieved adequate levels of quality control and reliability in their products and then designed around their expertise and business motivations.

The SMDC effort was primarily funded from the Joint Capability Technology Development Program from the Office of the Secretary of Defense.

NASA provided primarily full-time-equivalent support for various design analysis. These analyses were in areas of aerodynamic modeling and database development,

stage and fairing separation analyses, nozzle designs via computational fluid dynamics (CFD), vehicle performance independent assessment, buffet estimates, loads and dynamics analyses, aerothermal analyses, venting and purge analysis, liftoff and ascent aeroacoustics, mass properties, and ground systems and operations development. NASA also provided testing support in the form of wind tunnel test and engine testing at NASA Marshall Space Flight Center.



Model of SWORDS vehicle and assorted ground support equipment.



SWORDS engine testing at 75% power level.

Anticipated Benefits

A dedicated nanosatellite launcher can extend the miniature electronics revolution into space by enabling customers to have a launch-on-demand capability. SWORDS was intended to place nanosatellites into precise low-Earth orbits to provide capabilities both where and when they are needed. Nanosatellites will no longer have to wait months or years for piggyback rides subject to the schedule and orbital locations of other payloads. SWORDS would allow the affordable maintenance of constellations of nanosatellites in low-Earth orbit to provide communications and other services at an unprecedented low level of mission command, regardless of where customers are located.

Potential Applications

For NASA funded missions, SWORDS could provide a low cost, responsive launch capability for small satellites, for example CubeSats, for many of NASA's ongoing scientific missions.

For other government agencies, e.g., the U.S. Army, SWORDS could provide a low cost, responsive launch capability for small satellites to support the soldier in the field, and there are many other uses for other government agencies to place small, low cost satellites into orbit.

Notable Accomplishments

The SWORDS project successfully advanced several technologies needed to support a possible low cost launch vehicle, as follows: (1) The design of a multi-lobed/open-interstage vehicle has led to increased knowledge of flow characteristics using wind tunnel and CFD analysis, (2) The advancement of engine modeling and improved test capability resulted in the successful testing of a 60,000-lbf class liquid oxygen (LOX)/methane engine. This is currently the most powerful LOX/methane engine to have been tested in the world, (3) Analysis of four-engine impingement effects for thrust differential controllability, acoustics, and plume interaction has led to a better understanding of effects of using engine throttling for vehicle control, (4) Design and testing of a unique engine cross-section (ob-round) and asymmetric nozzle increased understanding of the efficiency losses of this type of engine design, (5) Use of low-cost commercial technology for launch vehicle avionics showed the viability of use for launch vehicle applications, and (6) The launch concept of operations developed for a 'universal' small launch system that can be used not only for a SWORDS type vehicle but also for any other small launch vehicle developed in the future.