NASAfacts

Space Technology
Game Changing Development
Deep Space Engine (DSE) 100 lbf and 5 lbf Thruster Development and Qualification

Science mission studies require spacecraft propulsion systems that are high-performance, lightweight, and compact. Highly matured technology and low-cost, short development time of the propulsion system are also very desirable. The Deep Space Engine (DSE) 100-lbf thruster is being developed to meet these needs. The overall goal of this game changing technology project is to qualify the DSE thrusters along with 5-lbf attitude control thrusters for space flight and for inclusion in science and exploration missions. The aim is to perform qualification tests representative of mission duty cycles.

Most exploration missions are constrained by mass, power and cost. As major propulsion components, thrusters are identified as high-risk, long-lead development items. NASA spacecraft primarily rely on 1960s' heritage in-space thruster designs and opportunities exist for reducing size, weight, power, and cost through the utilization of modern materials and advanced manufacturing techniques.

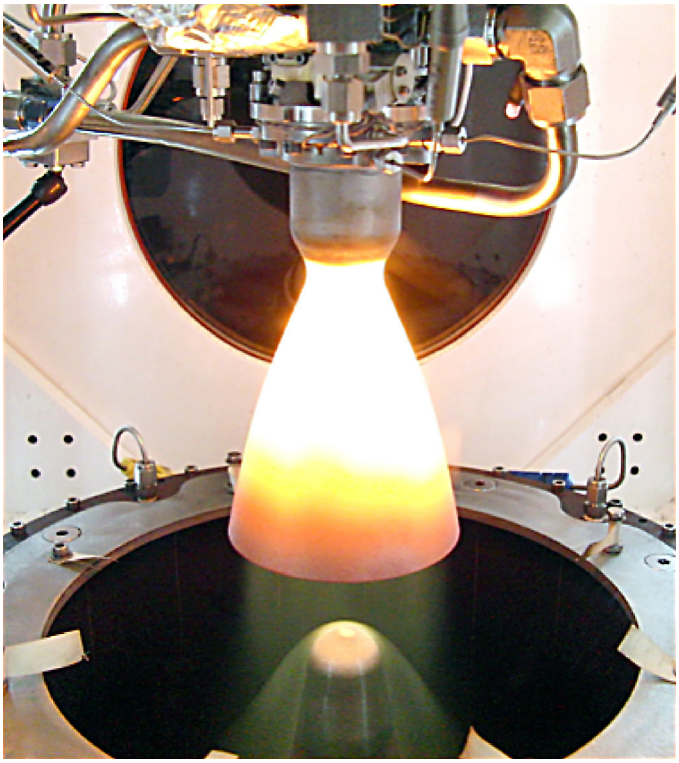
Advancements in MON-25/MMH hypergolic bipropellant thrusters represent a promising avenue for addressing these deficiencies with tremendous mission enhancing benefits. DSE is much lighter and costs less than currently available thrusters in comparable thrust classes. Because MON-25 propellants operate at lower temperatures, less power is needed for propellant conditioning for in-space propulsion applications, especially long duration and/or deep-space missions. Reduced power results in reduced mass for batteries and solar panels. DSE is capable of operating at a wide propellant temperature range (between –22 °F and 122 °F) while a similar existing thruster operates between 45 °F and 70 °F. Such a capability offers robust propulsion operation as well as flexibility in design.

NASA's Marshall Space Flight Center evaluated available operational Missile Defense Agency heritage thrusters suitable for the science and lunar lander propulsion systems.

Development DSE planned for hot-fire test at Advanced Mobile Propulsion Test in 2017.

Hot-fire tests of 5-lbf and 100-lbf thrust-class thrusters demonstrated that MDA heritage hardware can be improved to meet propulsion system development objectives: 1) lightweight thruster components as well as overall system; 2) low unit cost in comparison with conventional thrusters; 3) operation over the projected mission flight profiles, total burn times, and entire mission duration; and 4) operation with cold propellants (MON-25/MMH) for minimizing the heater power requirement and in space environments.

DSE is an enabling technology that is directly relevant to NASA's vision, missions, and long-term goal of expanding exploration into the solar system. Development hot-fire testing of two 100-lbf thrusters and two 5-lbf thrusters is scheduled to be completed in 2018. After adjustments to the manufacturing processes to include welded connections, two 100-lbf and two 5-lbf design verification thrusters will be fabricated and tested in late 2017. Qualification testing is to be performed in 2018.



Frontier Aerospace work horse hardware—hot-fire testing in vacuum.

DSE is an improved in-space chemical propulsion thruster. It offers multipurpose space mission utilization and economy-of-scale benefits because the engine is adaptable for spacecraft main propulsion, reaction control systems, and lander descent/ascent. Reducing propulsion system weight and volume increases available payload mass and/or acceleration capability, thereby expanding launch vehicle opportunities. Reduced propellant freezing point and thermal management power draw enables long duration ultra-cold deep space missions and reduces spacecraft heater power demand. Additionally, DSE retains fine grain impulse bit control for more precise control of lander descent/ascent trajectories.

DSE offers enhanced affordability through improved designs, modern materials, and advanced manufacturing processes, which lower thruster unit cost for missions and reduce propulsion system costs. This technology is key to the enhanced affordability of science and exploration missions.

The Game Changing Development (GCD) Program investigates ideas and approaches that could solve significant technological problems and revolutionize future space endeavors. GCD projects develop technologies through component and subsystem testing on Earth to prepare them for future use in space. GCD is part of NASA's Space Technology Mission Directorate.

For more information about GCD, please visit
http://gameon.nasa.gov/

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FS-2017-07-78-MSFC