

# Space Technology Game Changing Development Thruster Advancement for Low-temperature Operation in Space

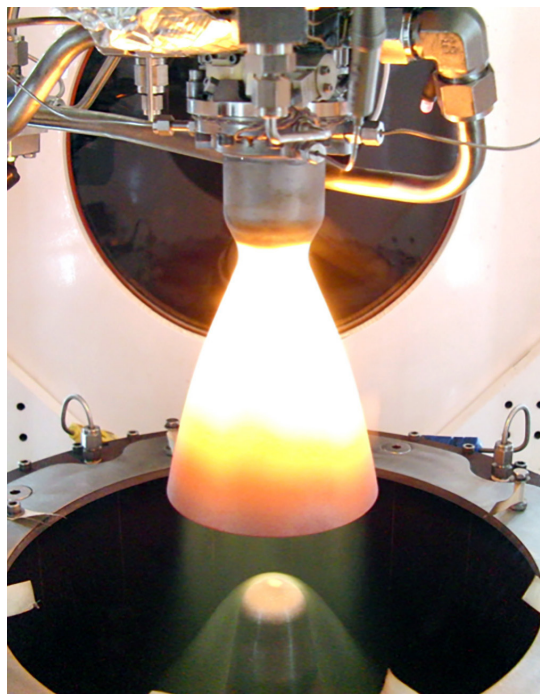
## TALOS

NASA is poised to return to the Moon and then farther out to deep space. These goals will require spacecraft landing propulsion systems compact. Highly matured technology and low-cost, short development time of the propulsion system are also needed to support multiple lunar missions within a short timeframe. The Thruster Advancement for Low-temperature operation in space (TALOS) thrusters are being developed to meet these needs. The overall goal of this game changing technology project is to qualify the TALOS thrusters for space flight on a lunar demonstration mission with the long-term goal of a reliable, commercial-off-the-shelf option for future science and exploration missions. The TALOS project will perform qualification tests representative of a planned mission duty cycle for an Autonomous Lander in a Lunar Demonstration Mission. The lunar demonstration mission will grant the TALOS a space-flight heritage that will solidify its position as a go-to option for future Deep Space Missions. Much like NASA's ambitious exploration goals, the TALOS project will prove its mettle in the lunar mission before venturing out on deeper space missions.

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. Advances in materials and manufacturing technology now offer advantages to reduce thruster size, weight, power, and cost for future missions.

Advancements in MON-25/MMH hypergolic bipropellant thrusters represent a promising avenue for addressing these deficiencies with tremendous mission enhancing benefits. TALOS is lighter and costs less than accessible thrusters in comparable thrust classes. Because MON-25 operates at lower temperatures, less power is needed for propellant conditioning for in-space propulsion applications,



*Frontier Aerospace work horse hardware – hot-fire testing in vacuum chamber.*

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especially long duration and deep-space missions. Reduced power requirements for propellant conditioning results in reduced mass for batteries and solar panels. TALOS is capable of operating at a wide propellant temperature range (between -22 °F and 80 °F) while a similar thruster operates between 45 °F and 70 °F. Such a capability offers robust propulsion operation as well as flexibility in design.

TALOS aims to create lightweight thruster components that have a low unit cost in comparison with conventional thrusters and superior performance and burn times than current thrusters. TALOS thruster will also be able to operate with cold propellants (MON-25/MMH), which will minimize the heater power requirement for in-space environments.

The TALOS thruster is being developed by Frontier Aerospace Corporation of Simi Valley, CA. TALOS is an enabling technology that is directly relevant to NASA's vision, missions, and long-term goal of expanding exploration into the solar system. Hot-fire testing of two 150-lbf thrusters and two 10-lbf thrusters is scheduled to be completed in 2020.

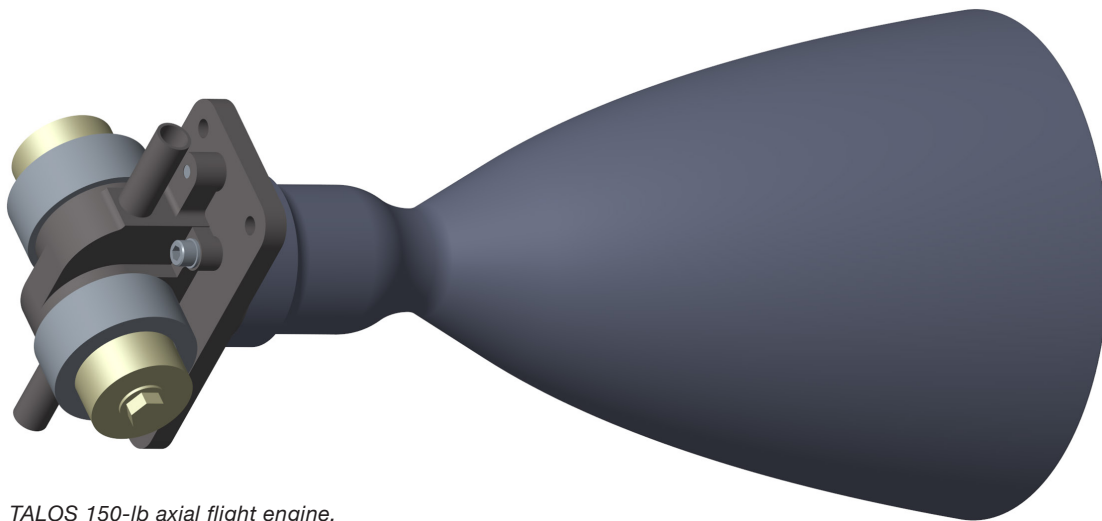
TALOS is an improved in-space chemical propulsion thruster. It offers multipurpose space mission utilization

and economy-of-scale benefits because the engine is adaptable for spacecraft main propulsion, reaction control systems, and lander descent and ascent. Reducing propulsion system weight and volume increases available payload mass and 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, TALOS will offer a more precise control of lander descent and ascent trajectories.

TALOS 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 is part of NASA's Space Technology Mission Directorate. The GCD program aims to advance exploratory concepts and deliver technology solutions that enable new capabilities or radically alter current approaches.

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



*TALOS 150-lb axial flight engine.*

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