Additive Manufacturing Technology for a 25,000 lbf LOX/Methane Mars Ascent Engine, Phase I Project

SBIR/STTR Programs | Space Technology Mission Directorate (STMD)

ABSTRACT

Masten Space Systems proposes a Phase I SBIR effort in support of the preliminary development of a 25,000 lbf additively manufactured (AM), aluminum alloy, liquid oxygen (LOX)/methane engine for in-space propulsion. The use of AM processes have the potential to realize transformative mass, cost, and schedule savings over current state of the art in the 25,000 lbf thrust class that will enable human and robotic missions to Mars and beyond. The proposed effort will utilize Masten?s experience in engine design and fabrication as well its experience with AM processes. Masten has prior experience in the use of additive manufacturing for high thrust engine hardware and will build on this heritage for the in-space propulsion application proposed in this Phase I effort. Specifically, the proposed AM engine design approach employs innovative regenerative cooling channel geometries that leverage the design freedom of AM to maintain adequate chamber cooling.

ANTICIPATED BENEFITS

To NASA funded missions:

Potential NASA Commercial Applications: Evolvable Mars Campaign. A Masten Mars Ascent engine presents new mission architecture for NASA?s proving ground missions and in exploration beyond to deep space destinations. Technology demonstrations of MMA's in-space propulsion and ascent capabilities will target NASA's cislunar (short stay and long stay) cis-Mars robotic, Mars orbit, and Mars surface missions. The cost and mass savings that comes with the use of additive manufacturing along with Masten?s expertise in engine component and systems development presents a needed and affordable opportunity to prove the reliability of critical systems and operations techniques on which missions into deep space will depend. K. C. Laurini and M. M. Gates, NASA's Space Exploration Planning: The Asteroid Mission and the Step-Wise

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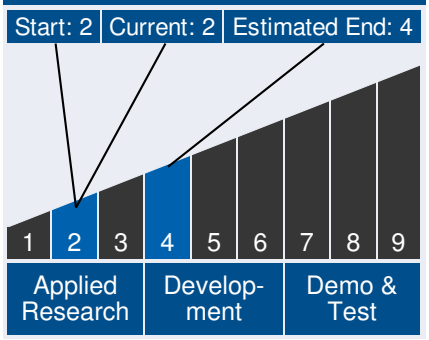
Technology Maturity



Management Team

Program Executives:

- Joseph Grant
- Laguduva Kubendran

Program Manager:

- Carlos Torrez

Continued on following page.

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Path to Mars, 65th International Astronautical Congress, Toronto, Canada, Copyright 2014 by the International Astronautical Federation.

To the commercial space industry:

Potential Non-NASA Commercial Applications: DARPA XS-1 This DARPA Tactical Technology Office (TTO) Experimental Spaceplane (XS-1) initiative has contracted Boeing, Northrop Grumman, and Masten in the first phase of development for a reusable first stage launch vehicle that will fly 10 times in 10 days, to Mach 10+ at least once and launch a demonstration payload to orbit. Masten?s design will develop a vertical takeoff vertical launch (VTVL) system with return to launch site capability and a reusable booster to launch 1500+ kg payloads to orbit. Masten's XS-1 design, known as Xephyr, builds on Masten's award-winning VTVL heritage, aircraft-like reusability, reliable propulsive control, high tempo operations, and unprecedented price per launch. Propulsion for the Xephyr reusable vehicle will be the 65,000lbf+ LOX/methane booster Broadsword engine, which is currently in prototype development. Commercial Launch Vehicles An accelerated production of small satellites and new applications are driving up demand for nontraditional launches, and demand for launches is projected to continue to increase significantly as payload development and launch costs decrease. Satellite operators and vendors are targeting shorter lifespan satellites, less expensive buses, and lower launch costs, as they migrate from a handful of large geostationary assets toward constellations of small satellites in LEO. As a result, increased responsiveness and reduced cost launch vehicles are poised to reshape the small payload launch market.

Management Team *(cont.)*

Principal Investigator:

- Jake Teufert

Technology Areas

Primary Technology Area:

In-Space Propulsion Technologies (TA 2)
└ Chemical Propulsion (TA 2.1)
  └ Liquid Cryogenic (TA 2.1.2)

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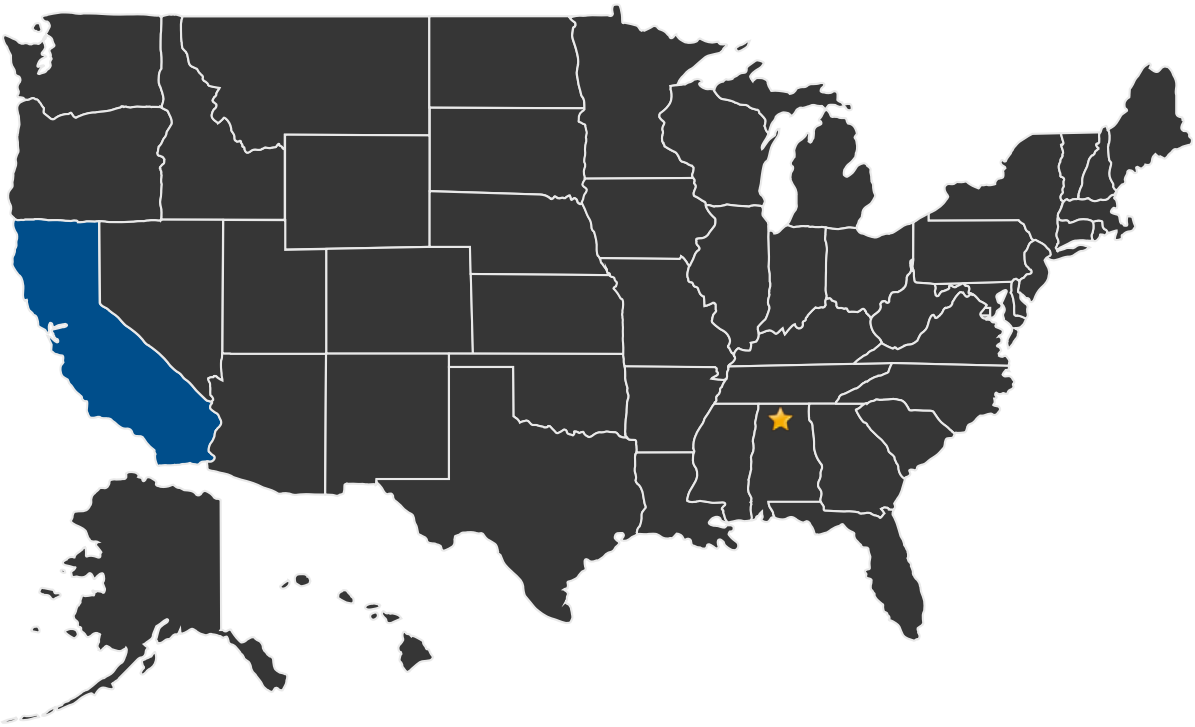
U.S. WORK LOCATIONS AND KEY PARTNERS



U.S. States With Work

Lead Center:
Marshall Space Flight Center

Other Organizations Performing Work:

- Masten Space Systems, Inc. (Mojave, CA)

PROJECT LIBRARY

Presentations

- Briefing Chart
  - (http://techport.nasa.gov:80/file/23143)

IMAGE GALLERY

Additive Manufacturing Technology for a 25,000 lbf LOX/Methane Mars Ascent Engine, Phase I

DETAILS FOR TECHNOLOGY 1

Technology Title

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Potential Applications

Evolvable Mars Campaign. A Masten Mars Ascent engine presents new mission architecture for NASA?s proving ground missions and in exploration beyond to deep space destinations. Technology demonstrations of MMA's in-space propulsion and ascent capabilities will target NASA's cislunar (short stay and long stay) cis-Mars robotic, Mars orbit, and Mars surface missions. The cost and mass savings that comes with the use of additive manufacturing along with Masten?s expertise in engine component and systems development presents a needed and affordable opportunity to prove the reliability of critical systems and operations techniques on which missions into deep space will depend. K. C. Laurini and M. M. Gates, NASA's Space Exploration Planning: The Asteroid Mission and the Step-Wise Path to Mars, 65th International Astronautical Congress, Toronto, Canada, Copyright 2014 by the International Astronautical Federation.