

Additive Manufacturing for Affordable Rocket Engines

Description

Additive manufacturing (also known as 3D printing) technology has the potential to drastically reduce costs and lead times associated with the development of complex liquid rocket engine systems. NASA is using 3D printing to manufacture rocket engine components including augmented spark igniters, injectors, turbopumps, and valves. NASA is advancing the process to certify these components for flight.

Success Story

MSFC has been developing rocket 3D-printing technology using the Selective Laser Melting (SLM) process. Over the last several years, NASA has built and tested several injectors and combustion chambers. Recently, MSFC has 3D printed an augmented spark igniter for potential use the RS-25 engines that will be used on the Space Launch System. The new design is expected to reduce the cost of the igniter by a factor of four. MSFC has also 3D printed and tested a liquid hydrogen turbopump for potential use on an Upper Stage Engine. Additive manufacturing of the turbopump resulted in a 45% part count reduction.



Augmented Spark Igniter

To understanding how the 3D printed parts perform and to certify them for flight, MSFC built a breadboard liquid rocket engine using additive manufactured components including injectors, turbomachinery, and valves. The liquid rocket engine was tested seven times in 2016 using liquid oxygen and liquid hydrogen. In addition to exposing the hardware to harsh environments, engineers learned to design for the new manufacturing technique, taking advantage of its capabilities and gaining awareness of its limitations.



Liquid Hydrogen Turbopump

Benefit

The 3D-printing technology promises reduced cost and schedule for rocket engines. Cost is a function of complexity, and the most complicated features provide the largest opportunities for cost reductions. This is especially true where brazes or welds can be eliminated. The drastic reduction in part count achievable with 3D printing creates a waterfall effect that reduces the number of processes and drawings, decreases the amount of touch labor required, and increases reliability. When certification is achieved, NASA missions will be able to realize these benefits.

Lead NASA Center: Marshall Space Flight Center

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For more information: <https://techport.nasa.gov/view/?????TechPort ID number TBD>