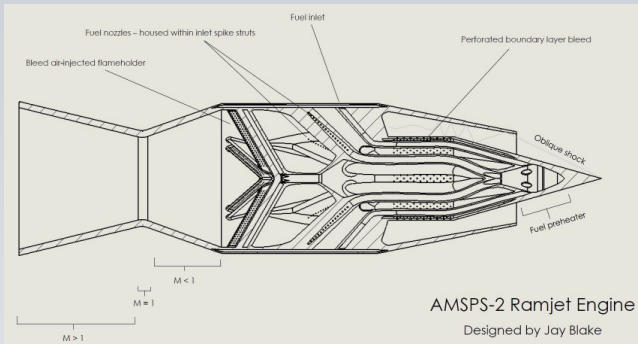


Fueling Advanced Ramjet Designs with Velo3D Metal 3D Printing



This ramjet engine designed by Velo3D Applications Development Engineer, Jay Blake, was developed in partnership with Lockheed Martin to demonstrate the industrial maturity of emerging in-situ process monitoring capability in the latest generation of laser powder-bed fusion additive manufacturing (AM) systems. It is designed for small unmanned reusable or nonreusable aircrafts flying at supersonic speeds. This display piece was printed on a 1-meter-tall Sapphire XC 1MZ in Inconel®718 as a solid piece without supports.

It was made possible with funding through LIFT, the Detroit-based national manufacturing innovation institute, in partnership with the Department of Defense.

Challenging Traditional Manufacturing

One of the major challenges in traditional manufacturing is achieving high aspect ratio structures while ensuring performance and efficiency gains. While studying this design, there was potential performance gain in using the fuel as a heat sink to manage aerodynamic heating while delivering hotter fuel to the combustor. Research suggested a performance increase by injecting bleed air into the wake of the flame holder, reducing parasitic drag while maintaining combustion efficiency.

Applying Velo3D's Advanced Metal Additive Manufacturing Technology

With Velo3D technology, our engineer was able to incorporate these performance and efficiency features with great dimensional accuracy despite the design's intricate internal channels. This part demonstrates the incredible benefits of AM including component consolidation, rapid prototyping, and complex internal architecture which would not be manufacturable with traditional manufacturing technology.

Critical Feature: Part Consolidation

The uniqueness of the design lies in how much functionality just one part serves. Building a system like this with traditional manufacturing methods can take months to years of development along with hundreds of individual components that would require brazing or welding. This component consolidates an inlet spike, heat exchanger, flame holder, struts, and fuel injectors into one-piece. It was printed in just eight days without supports.

Critical Feature: Perforated Boundary Layer Bleed

Velo3D technology made it possible for overall engine efficiency with a consistent perforated array of 500 μm holes. With this consistency and remarkable circularity, it minimizes the thermoacoustic instabilities and diffuses supersonic flow regimes caused in the inlet spike.

Critical Feature: Flow Channels

Velo3D unlocks the ability to produce parts with thin walls, lattice structures, and complex internal channels such as the flow channels of this ramjet. This can prove incredibly valuable in supersonic and hypersonic systems.

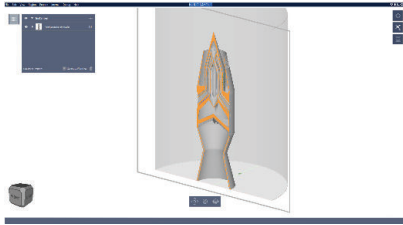
Critical Feature: Bleed Air-Injected Flame Holder

Due to Velo3D's non-contact recoater, the flame holder of this ramjet was printed completely without supports. As air flows inside, it is then ejected out of the wake of the flame holder, helping to maintain combustion and reduce some of the parasitic drag on the engine.



The Velo3D Fully Integrated Metal Additive Manufacturing Solution

Velo3D is at the forefront of innovation, pioneering an integrated advanced metal AM solution that combines pre-print design, advanced printing hardware, and in-situ quality assurance, all unified into one intelligent system. Our solution is built for reproducible, predictable outcomes for scalability without compromising design complexity or functionality.



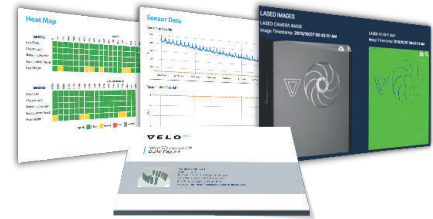
Flow

Print Preparation Software



Sapphire

Metal AM Family of Printers



Assure

Quality Validation

UNDERLYING INTELLIGENT FUSION MANUFACTURING PROCESS

By leveraging advanced metal AM, defense organizations can spearhead the advancement of critical part design that will drive our military into the future and create more agile supply chains. Engineering teams can discover new avenues for efficiency and performance in key components of engine systems.

A Secure, US-Based Solution

- Velo3D is a US-based solution – both developed and produced in the US – that’s compliant with Buy American Act requirements
- Tap into a secure, trusted network of contract manufacturers in the US and abroad
- Trusted by leaders in military and defense
- Capable of working with export-controlled data and operating in classified environments with data segregation routes to different servers based on need



GO BEYOND