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Author: Mr. Jeff Haynes
Aerojet Rocketdyne, United States, jeffrey.haynes@rocket.com

ADDITIVE MANUFACTURING LIQUID ROCKET ENGINE SYSTEMS

Abstract

Liquid rocket engine propulsion systems are highly complex and compact designs that delivery unsurpassed power and performance with unparalleled quality and confidence. The primary challenge facing the industry over the span of many years has been the affordability of such systems due to many factors. Low production volumes, retention of skilled labor forces, and limited manufacturing capacity all factor into these costs. Traditional manufacturing support of these systems typically requires long lead time tooling and raw material supply combined with high touch labor and precision assembly and joining processes. Recently, aerospace grade alloys have demonstrated the ability to be produced using various additive manufacturing techniques while retaining critical alloy performance characteristics. The benefits to this new manufacturing process can dramatically reduce tooling, lead times, support costs, and part count in these propulsion systems. Aerojet Rocketdyne has demonstrated a complex liquid oxygen / gaseous hydrogen coaxial swirl injector design produced entirely through additive manufacturing. The design and fabrication of this injector assembly culminated in a successful hot fire series at NASA-GRC in June of 2013. The challenge facing the industry now is not whether these dramatic leaps in capability are possible, but to develop the robust product form design data and inspection techniques to enable adoption from traditional customers into the liquid rocket engine propulsion trade space.