Industrialization of "Printed Propellant" Improving Industrial Base Efficiency, Flexability and Adaptability

S3028 — Additive Manufacturing of Igniter Grains

Objective

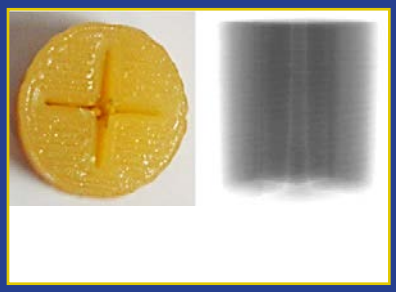
This objective of this project is to demonstrate and qualify a printable composite propellant and its use as a pyrogen igniter. Igniter grains – small propellant grains with complex geometries – have long lead times contributing to schedule delays and cost overruns. During development, lead times for casting tooling are often several months, including for each rework necessary. In production, many cast grains are rejected due to defects introduced during the removal from tooling. 3D printing grains eliminates these issues; the propellant may be mixed in the morning and printed in the afternoon without the need for any tooling. This results in reduced development time, which helps systems reach the fleet sooner, reduced part rejection, which improves manufacturing reliability and reduced resource demand, which enables industry to react more quickly during production surges.

Payoff

This Energetics Manufacturing Technology Center (EMTC) project represents a classic tech-pull and additive manufacturing (AM) business case supporting critical path schedule compression, more rapid fleet availability and system sustainment. Printing igniter grains is expected to eliminate the typical lead-time of one year associated with tooling, $100-200K in recurring tooling costs during development and the need to retool between production runs. It is also anticipated to increase production yield through a reduction of rejected parts while simultaneously eliminating machining requirements and associated energetic waste, thereby reducing component acquisition cost. With the ability to produce multiple assets or designs concurrently, the technology supports a more agile industrial base by freeing plant labor for other needs. Importantly, the technology may be utilized by any tri-service solid rocket motor or missile system for additional applications, such as launch motor grains or solid divert and attitude control grains. In the long-term, it is expected to support the testing and production of functionally graded propellant grains targeting range goals.

Implementation

Composite propellant additive manufacturing technology will be industrialized by transitioning materials and methods developed by the Navy to industry. An acrylate polybutadiene will be commercialized to supply production plants, government labs and igniter grain articles produced under this EMTC effort. The performance of the igniter grains will be assessed and a qualification plan implemented. Performance metrics include density, burning rate, maximum stress and strain at ambient, peak pressure and rise time. Upon completion of the qualification plan, the igniter grain will be implemented into the production pipeline and the basic technology will be utilized.



PERIOD OF PERFORMANCE:
February FY2024 to December FY2027

PLATFORMS:
Pyrogen igniters. D5 (demonstration article), SM6, PAC3, MPBD, OpFires, MRBM

CENTER OF EXCELLENCE:
Energetics Manufacturing Technology Center (EMTC)

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