

## **Phase 1 Project Summary**

Firm: Streamline Automation, LLC

Contract Number: NNX11CE26P

Project Title: High Duty Cycle, Extended Operation Constant Volume Combustion Engine

The C3 Propulsion division of Streamline Automation has designed, fabricated, and successfully tested a demonstration Constant Volume Combustion (CVC) engine. The CVC engine was designed for the injection of fuel and oxidizer at relatively low pressure, which allows the pressurization and propellant delivery to be lightweight. Once the propellants have been injected into the combustion chamber, they are ignited, and the pressure rises rapidly. When the pressure peaks, the pintle is opened allowing the high pressure combustion products to escape producing thrust.

A heavyweight demonstration prototype engine was designed for modular assembly, and ease of testing. Engineering analysis was performed on the engine to ensure that they would safely perform their intended function during testing. An initial scaling analysis was performed to ensure that the engine can be modified for specific applications.

Extensive pre-operational testing was performed to ensure that sufficient fuel and oxidizer flow into the engine could be achieved. The engine assembly was tested with high pressure nitrogen at 1000 psi in order to ensure that there was minimal leakage past the pintle seat or along the actuator shaft.

Extensive operational testing was performed on the engine with more than 1000 pulses generated. This testing demonstrated that it was possible to consistently achieve a chamber pressure greater than 1200 psi were achieved as evidenced by the lifting of the pressure relief valve on the combustion chamber. Since the relief valve lifted consistently, a relief valve with a higher set pressure (3000 psi) was installed in order to contain the peak pressure generated during combustion. This successful testing established a firm basis for additional prototype development in the Phase 2.

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