Introduction

The increasing frequency of rocket launches has led to the need to develop more environmentally-friendly or “green” rocket propellants. This research is investigating the effectiveness of liquid propellant combinations using nitrous oxide and alcohol fuels. The primary research goals are:

- To design and build a rocket engine and fuel delivery system for these unique oxidizer and fuel combinations.
- To evaluate the performance of nitrous oxide and ethanol as liquid propellants.
- To apply novel high-speed imaging diagnostic techniques to the rocket exhaust plume.

This research is in collaboration with Sandia National Laboratories. The experimental testing will be performed at the Energetic Materials Research and Testing Center (EMRTC) on the New Mexico Tech campus.

Rocket Engine Design

A modular rocket engine was designed for testing with liquid nitrous oxide and alcohol fuels. The design work included creating a fuel injection plate, combustion chamber, nozzle, thrust stand mounts, and an ignition system.

Rocket Engine Testing Facility

The facility is designed to accommodate static test firings of liquid and hybrid rocket engines with less than 250 pounds of thrust. Three important considerations for designing the facility were:

- Modular design
- Simplicity in modification for alternate use
- Operator and system component isolation for safety

Design began in September 2013, construction at EMRTC began in March 2014, completion and first test expected in February 2015.

Impact

New Mexico has a history of space propulsion research, including work at facilities including White Sands, Sandia National Laboratories, Los Alamos National Laboratory, EMRTC and the Spaceport. This research will directly impact the state by:

- Establishing New Mexico Tech as the premiere research institution in the state for rocket propulsion and educating rocket scientists.
- Establishing a test bed for companies to evaluate novel liquid propellant combinations, including potential Spaceport tenants.
- Developing new experimental techniques for analyzing rocket propulsion and combustion to support NASA and commercial efforts.
- Establishing computational modeling capabilities for evaluating potential rocket propellants and designs.

Results

The rocket engine components are in the process of being machined, with several of the parts having been completed in the past month. Completed components are shown below. The performance calculations show that the engine should operate at a thrust of 150 lbf. The test facility construction is almost complete and pressure testing is underway.

References & Acknowledgements

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