AEROJET ROCKETDYNE

Advanced High-Performance Minimum Smoke Propellants

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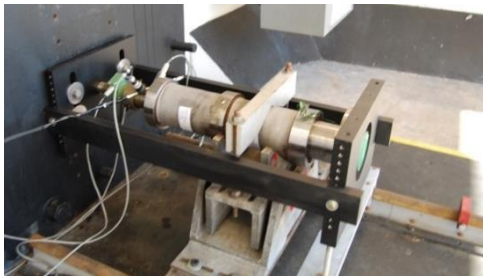
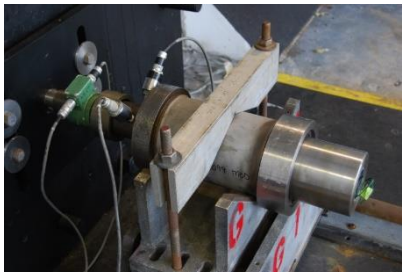
Project Objective and Impact

- The project objectives are to provide a minimum-smoke propellant formulation which will provide range improvement in a baseline system and provide Type IV fragment and Type V slow cook-off
  - The end-state of this project will provide the following:
    - Propellant + configuration giving range improvement
      - Increased I_{sp}, Increased I_{vol}, pressure, expansion ratio
    - Type IV fragment impact response
      - Energy partitioning (energetic binders)
    - Type V slow cook-off (at system level)
      - End-burning, Composite case + Forward and aft passive venting is critical for SCO
- Impact Summary
  - Current baseline minimum-smoke propellants exhibit Type I fragment impact response. Enhancements in fragment impact through lower sensitivity ingredients will provide IM enhancement without energy/performance degradation.
  - Target ingredient manufacture supported by continuous reactor technology for future manufacturing (MRL) improvement

Background – IHPRPT Phase III

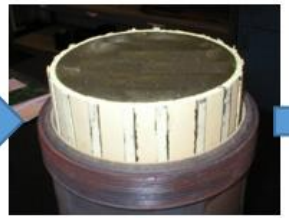
- Under IHPRPT Phase III, high performance propellant development was conducted to meet NOL Class 1.3
- Ingredients/Formulation to JEMTP TRL-5
- Many ingredients screened for performance (aluminized system)
- Improved energetic materials found to add performance and reduce sensitivity - scaled to pilot plant level
- Shock sensitivity in NOL LSGT less than 70 cards
- Motor demonstration confirmed high efficiency and high specific impulse





Technical Approach - Overview

- Technical Approach:
  - 1) Identify combinations of higher performance insensitive minimum-smoke ingredients based on heterocycles to meet performance,
  - 2) Characterize the downselected formulation and demonstrate useful mechanical properties, cook-off, and fragment impact characteristics at the subscale level, and
  - 3) Demonstrate performance in an end-burning heavywall demonstrator motor with features for desirable ballistic properties to match fielded system.

Insensitive Ingredients	Formulations	Motor Demonstrator	Motor Test
Year 1	Year 2	Year 3	Year 3
			

Goal of approach is to bring improved performance to the motor level

Motor Demonstration

- End-burning grain configuration selected for motor demonstration
  - Developed formulation from this effort incorporated into motor for higher performance
  - Finalized design to be addressed in year three; end-burning configuration being evaluated
  - Slow cook-off and fragment impact benefits from end burning grain configuration
- Two motor demonstrators to be considered:
  - HW 6” diameter (shown) preferred
  - HW 2.75” diameter uses less propellant (lowers need for experimental materials)

Motor demonstration planned in Year 3

Applications and Transition Potential

- The technology will provide increased performance with IM benefits through the use of demonstrated insensitive propellant ingredients. This will increase the range of a future tactical minimum smoke motor: Hellfire, TOW, or Javelin or similar variant missile system."
- This effort also complements other efforts: the insensitive propellant ingredients were initially used in aluminized systems with demonstrated performance increases.
- Other technologies, especially composite case, and energetic bonded closures could be combined with this technology.
- Target weapon system or systems are minimum smoke rocket motors such as Hellfire, TOW, and/or Javelin.

Questions?