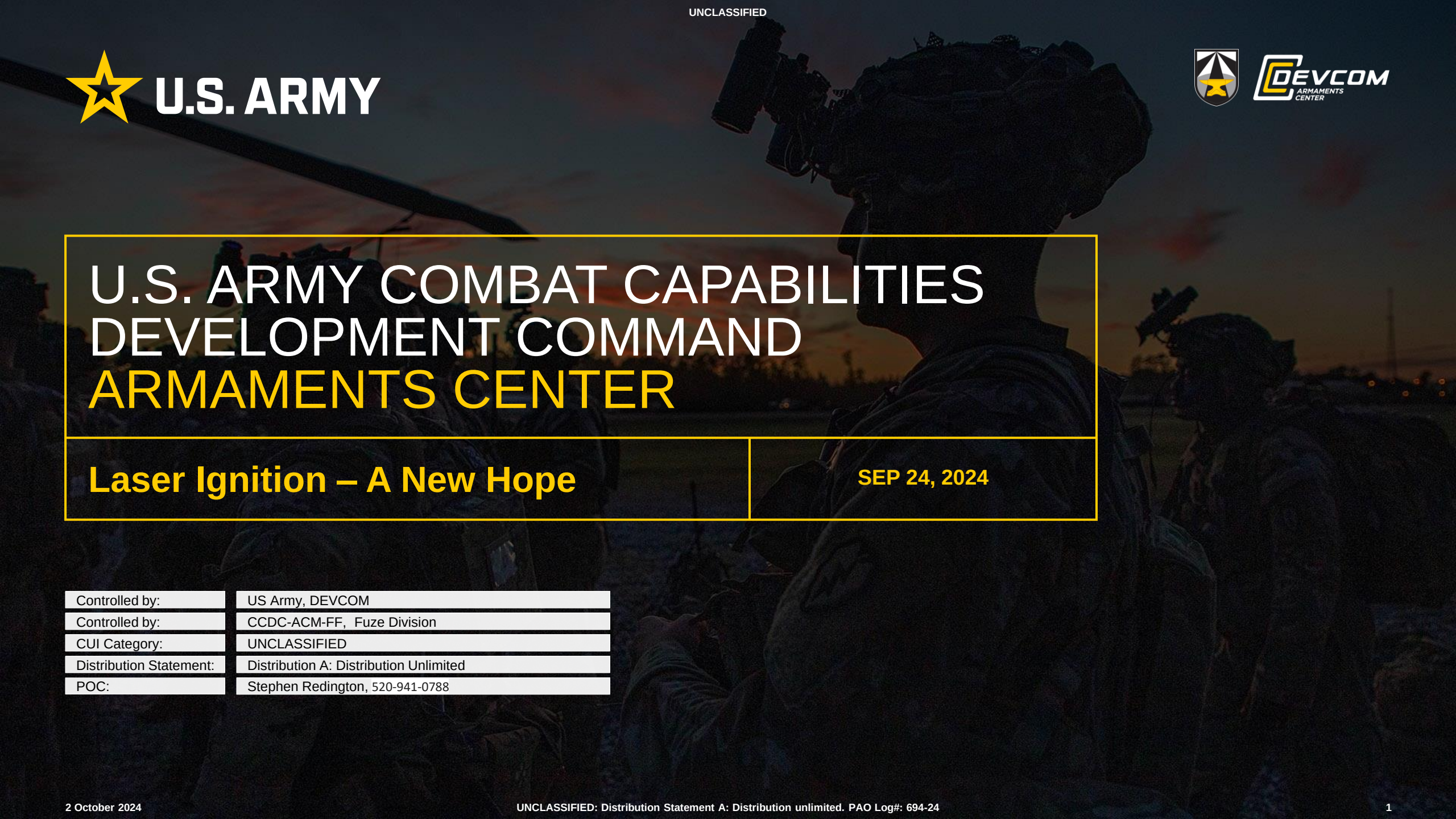

U.S. ARMY

DEVCOM ARMAMENTS CENTER

U.S. ARMY COMBAT CAPABILITIES DEVELOPMENT COMMAND ARMAMENTS CENTER

Laser Ignition – A New Hope

SEP 24, 2024

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POC:	Stephen Redington, 520-941-0788

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- **Who Are We?**
  - Fuze Technology Prototype Advancement Center - FTPAC
    - AKA the Fuze Development Center (FDC)
  - Energetics Assembly and Testing Facility
  - Electro-Mechanical Fab and Assembly Facility
  - Electromagnetic Environmental Effects (E^3) Testing Facility
- **What Are We?**
  - A state-of-the-art Electro-Mechanical Fabrication and assembly line with energetics handling and E^3 evaluation capabilities
  - Representative of a typical full service modern Contract Manufacturer
  - Focused on process and documentation. Repeatable results are our objective.
- **What Do We Do?**
  - Support the R&D mission by fabricating prototypes and hardware for fuze, munitions and other military applications
  - Our mission is not manufacturing but to make it manufacturable.

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OVERVIEW

- Introduction
- A Brief History
- The Potential for Laser Ignition
  - Automotive Industries
  - Aerospace Industries
  - Commercial Markets
- New Interests / Motivations
  - Micro Thrusters / Impulse Engines
  - Rocket Motor Igniters
  - CAD / PAD applications
- The Future

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INTRODUCTION

- **What is laser ignition?**
  - The transformation process of a combustible material, from an unreactive state to a self-propagating state, where the ignition source can be removed without extinguishing the combustion process [1].

[1] P.D. Ronney
Laser versus conventional ignition of flames
Optical Engineering, 33 (1994), pp. 510-521

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INTRODUCTION

- **Why is it desirable?**
  - **Safer**
    - ➢ Separation of input energy from output energy by means of photonic transduction (i.e. no physical contact).
    - ➢ Non-linear (diode) response provides a clearly defined energy barrier unlike linear (resistive) response that has a large ‘grey zone’.
  - **More manufacturable**
    - ➢ No fragile bridge wires. Minimal touch labor
    - ➢ Can utilize standard electronics automated assembly processes
  - **More Reliable**
    - ➢ Can be 100% tested

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DEMONSTRATED SUCCESSES (IN ORDER)

- Direct 155mm propellant initiation without a primer (megawatt laser)
- Laser ignition of metastable intermolecular composite (MIC)
- 30mm primer replacement
- Laser ignition of black powder
- M123 primer replacement
- Laser ignition of M6 blasting cap
- Laser ignition of zirconium and potassium perchlorate (ZPP)
- Laser Squib initiator

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BARRIERS TO ENTRY

- Culture
  - Incentive to proceed is lacking
  - If it ain’t broke, don’t fix it.
- Business case
  - High startup unit cost vs an established mass-produced unit cost is difficult to justify
- No production history
  - Risk vs reward

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TIMES ARE CHANGING

- Culture
  - My supply chains are breaking. I need to fix it.
  - They don’t make that anymore. I need something new

- Business case
  - Supply chain issues are making schedule and cost a significant problem
  - Manual labor / skill is becoming a problem
  - I really need HERO safety

- No production history
  - Maybe the risk is acceptable since I can’t get what I need now

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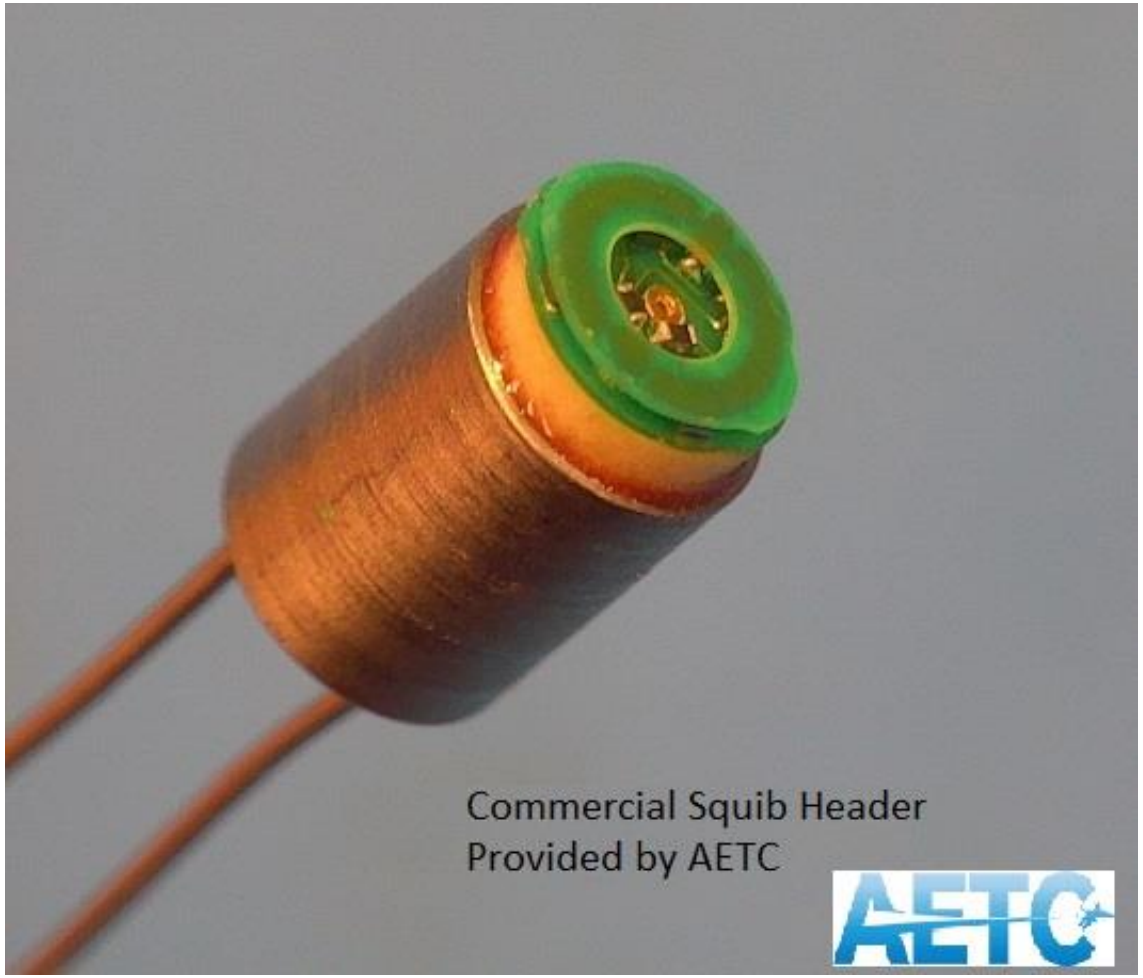
LASER IGNITED SQUIBS

- Hazards of Electromagnetic Radiation to Ordinance (HERO) Safe
- Eliminates fragile bridgewire
- Friendly to fully automated assembly
- 100% testable
- Successfully tested in 2023 at AETC
- Used in Cartridge Actuated Devices / Percussion Actuated Devices (CAD / PAD)
- Used in fire suppression systems



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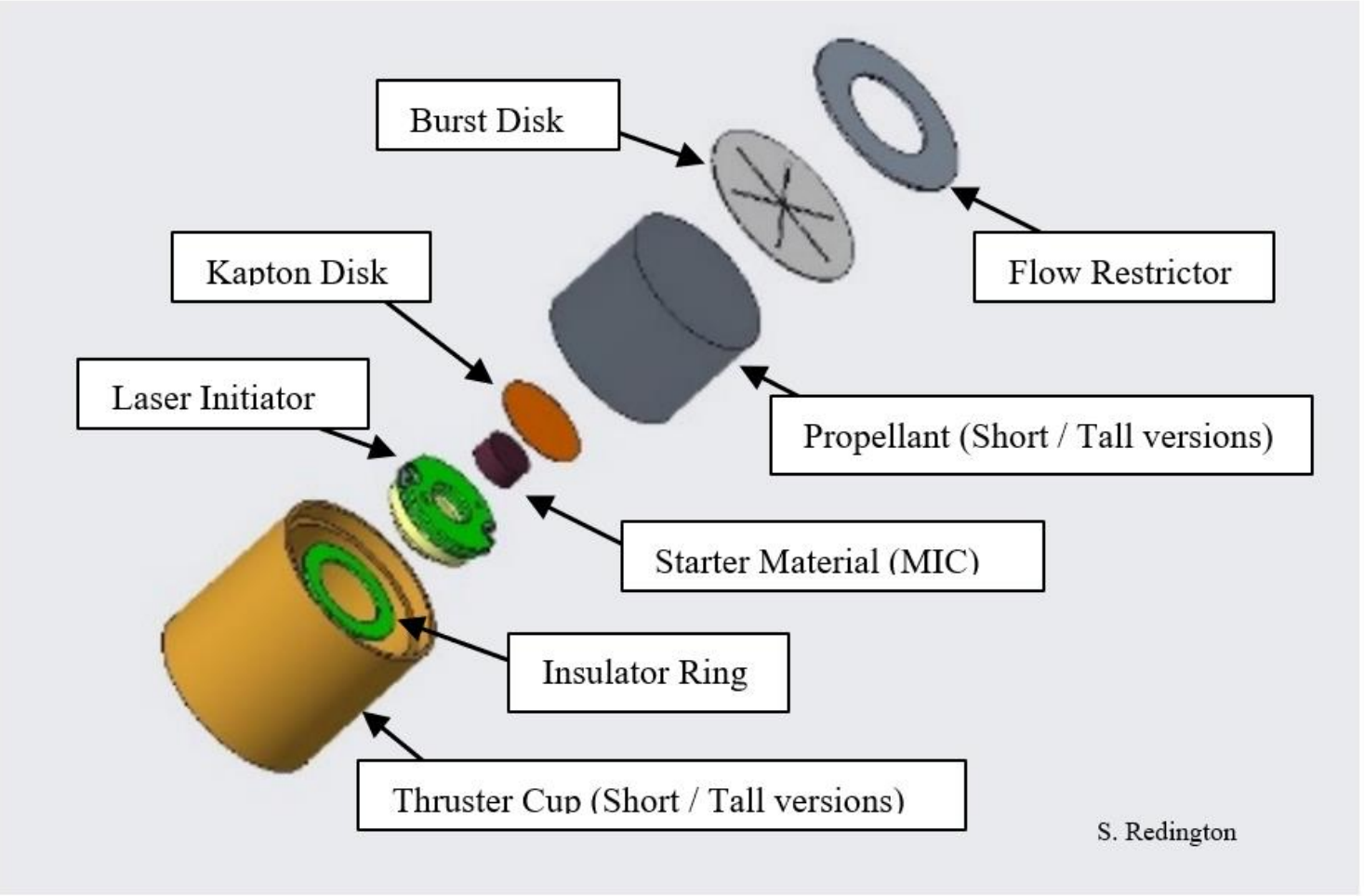
LASER IGNITED THRUSTERS

- Reuse 30mm primer technology
- Provides HERO safety
- Modular construction
- Delivers a single impulse for in flight maneuvers
- Fast initiation (~100 uS)



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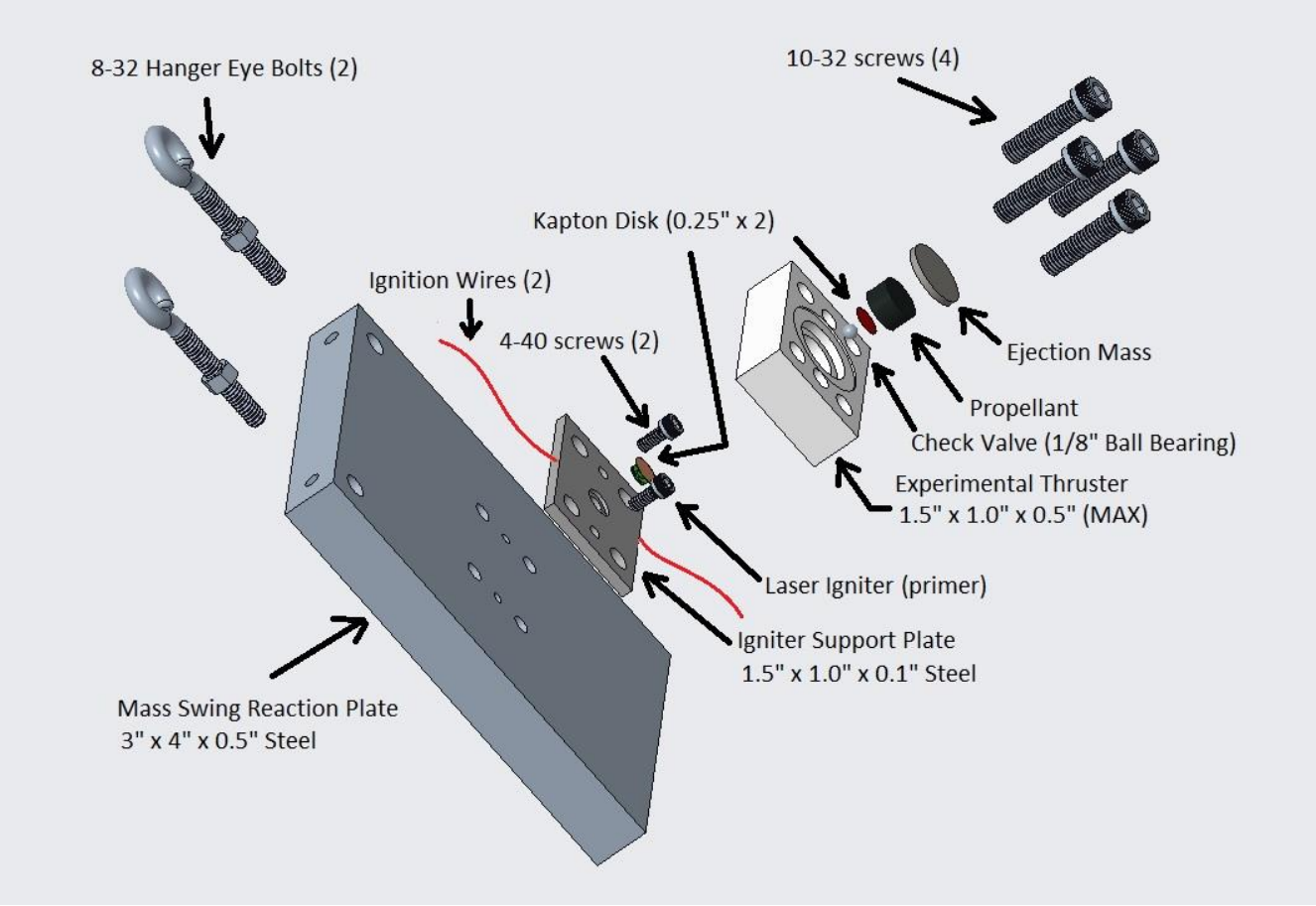
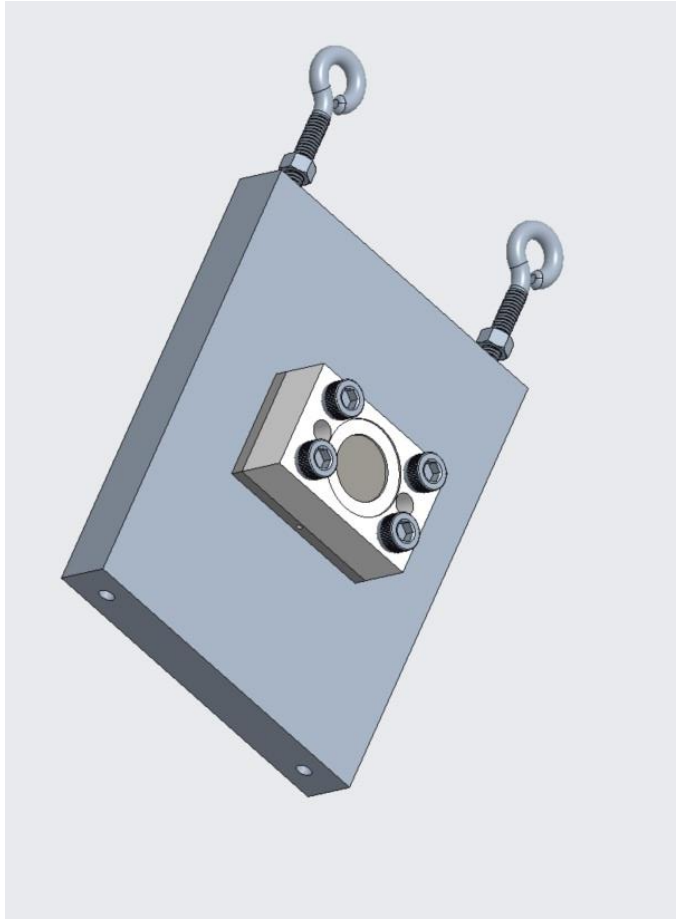
LASER IGNITED THRUSTERS





Impulse Measurement

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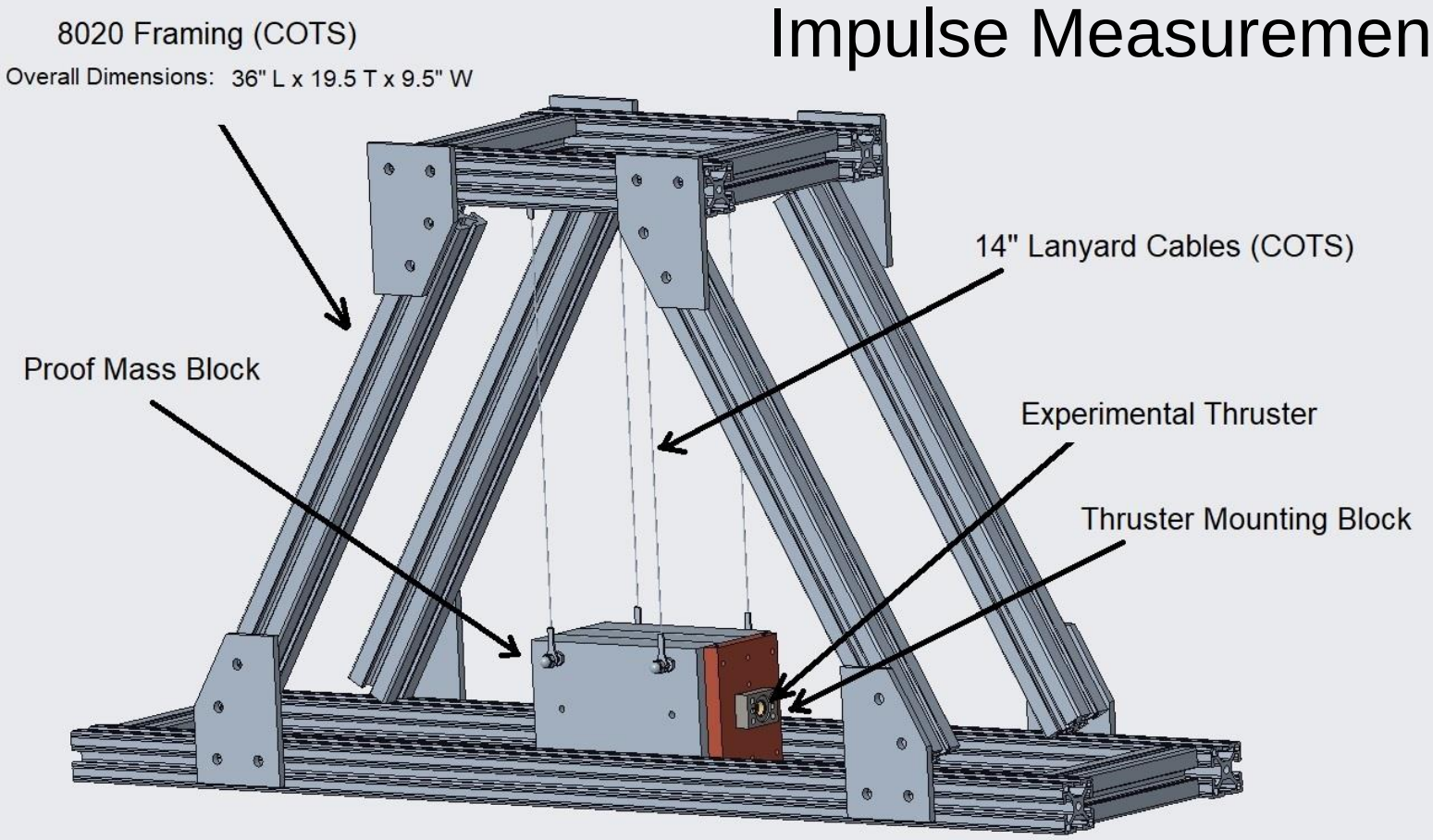
LASER IGNITED THRUSTERS



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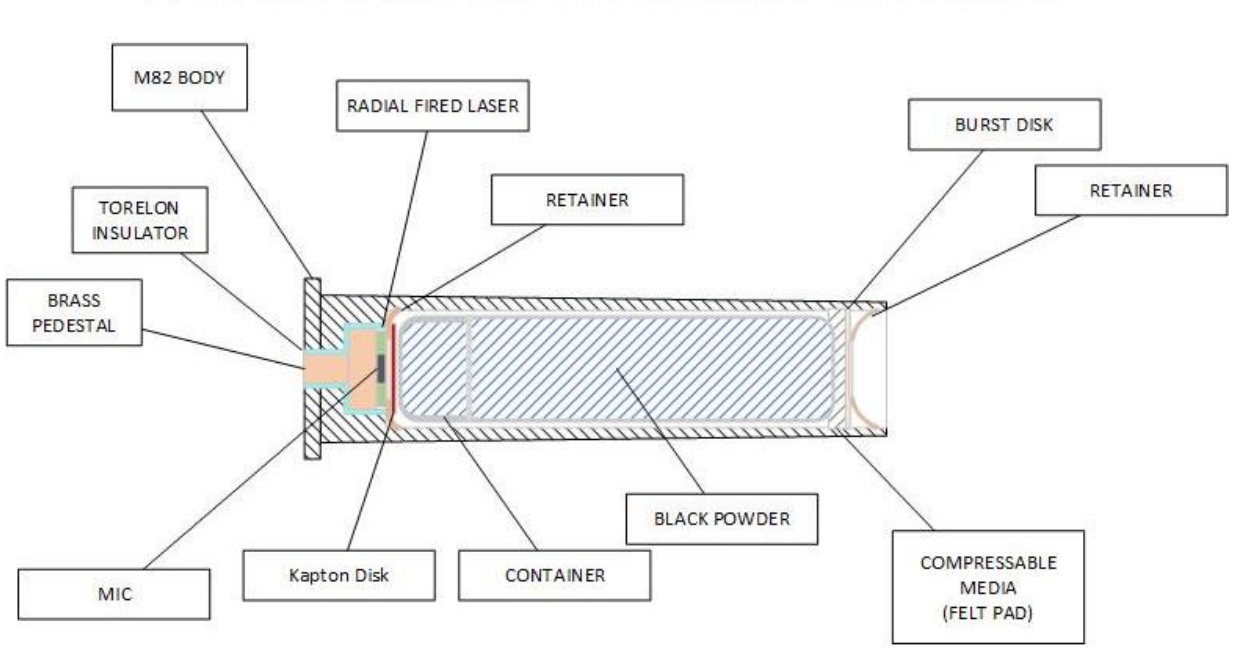
LASER IGNITED M82 PRIMER

- Potential alternate to production M82 primers that are in short supply due to supply chain issues.
- Investigated as an alternate primer for use at US based test ranges to free up M82 primers for the field
- Much simpler construction
  - Lower cost
  - More reliable
- Would require minor gun platform upgrade
  - Electric vs Percussion



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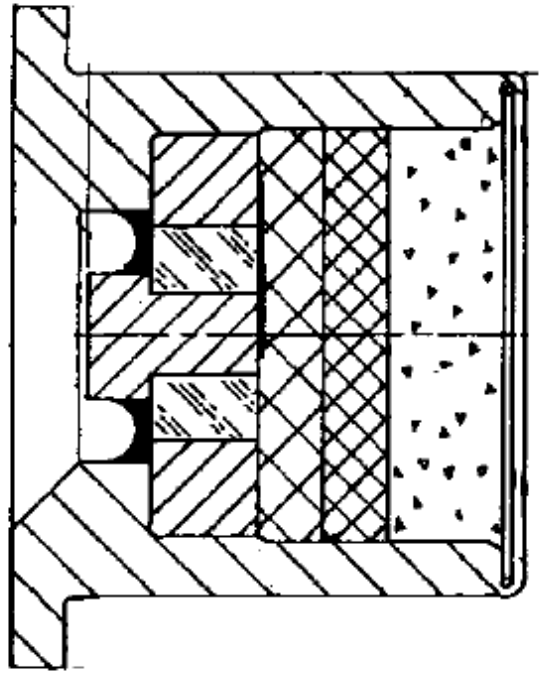
AIRCRAFT COUNTERMEASURE FLARES

- Potential alternate to production M796 primers.
- Improved reliability in high vibration environments
- Friendly to fully automated assembly
- 100% testable preassembly
- Pre function continuity check
- Post function confirmation check



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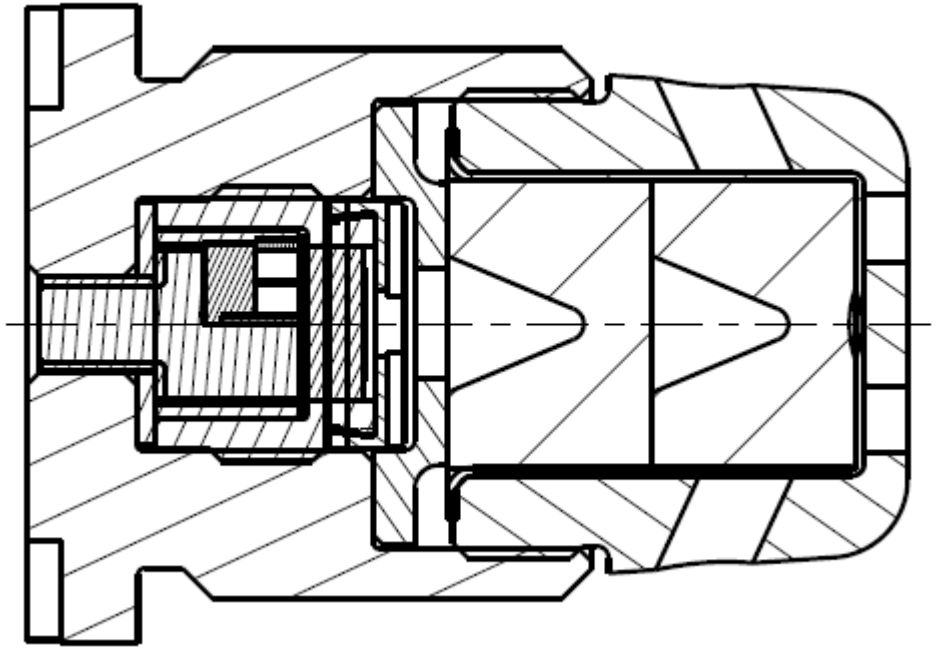
LASER IGNITED M123 PRIMER

- Potential alternate to production M123 primers that are difficult to procure due to supply chain issues.
- Viability demonstrated in 2019
- Much simpler construction
  - Lower cost
  - More reliable
- Would be drop in replacement



QUESTIONS?

THANK YOU.

For more information feel free to contact:

Stephen Redington: stephen.h.redington.civ@army.mil

DEVCOM Fuze Division POC:
sean.w.beighley.civ@army.mil