47th NDIA Annual Fuze Conference

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An Empirical Study of the M739A1 S&A Device Operational Range

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Purpose

- Extend the arming distance of the MOFA S&A to meet the US Navy EX437 Multi Option Fuze requirement
  - 400 feet no arm
  - 900 feet all arm
- MOFA requirements (155 mm)
  - 400 caliber
  - 400*155/304.8 = 203 feet

M739 S&A History

- Gearless S&A
  - No hob
  - Cast components
  - Unusual tooth design and pressure angles
  - Unusual design location
  - Dry film lubrication

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Functional Description

- S&A rotor contains M55
- Rotor held safe by setback pin and spin detents
- Setback removes pin
- Spin releases detents
- Spin drives rotor through escapement
  - Essentially a turns to arm arrangement

Considerations for Increasing Arming Time

- Rotor Gear
  - 9 tooth sector gear, snap to arm
- Rotor mass
  - Zinc cast, eccentric mass
- Pallet
  - Brass stamping, oscillation rate

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Rotor Assembly

Rotor Mass

Rotor Material	Mass
Zinc Die-Cast	3.95 grams
Aluminum	1.73 grams

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Pallet

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Pallet

Pallet Configuration	Weight
Standard	0.2762 grams
Modified 1-A	0.3335 grams
Modified 1-B	0.3294 grams
Modified 2	0.4469 grams

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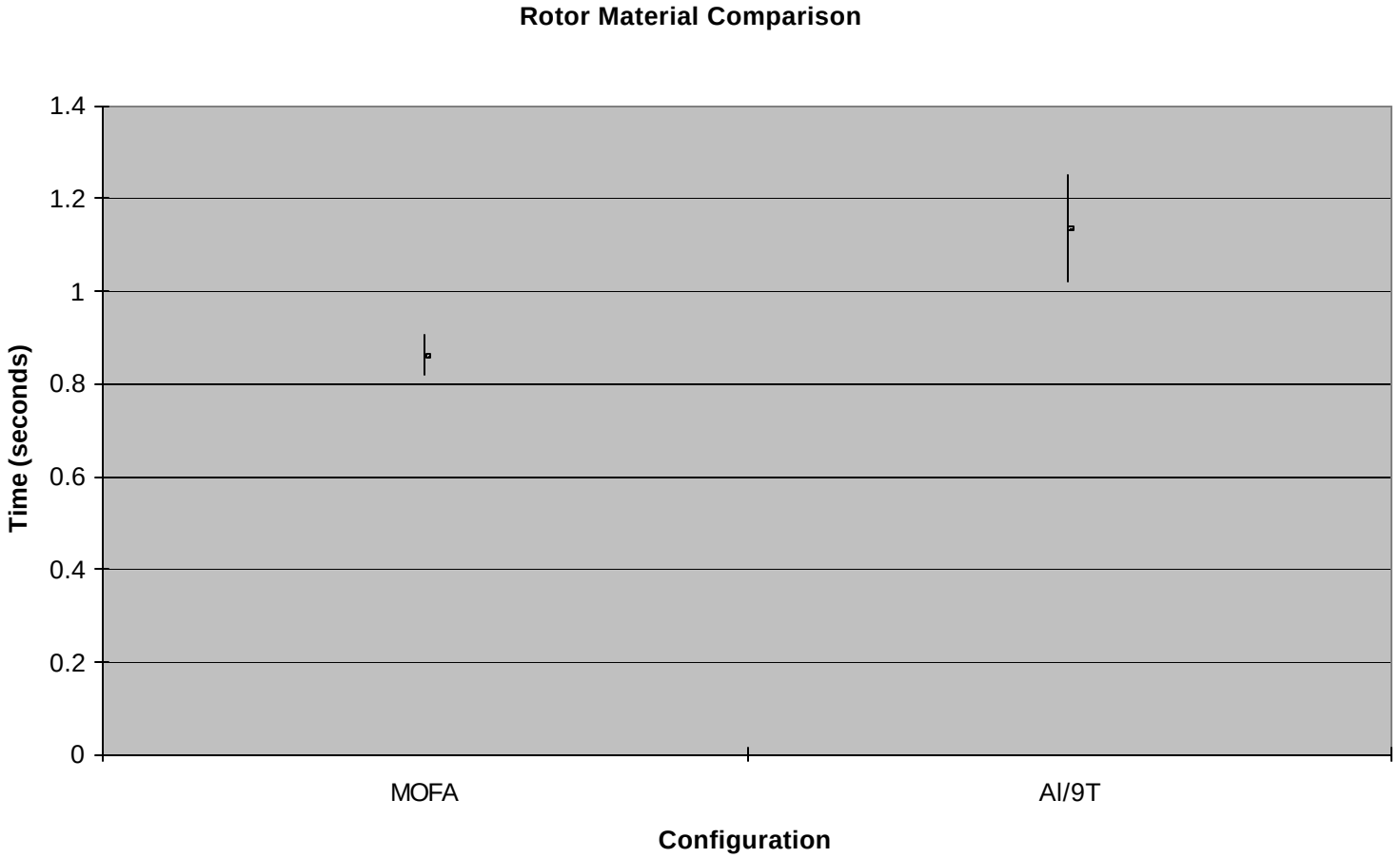
Arming Distance Estimate

- M782 S&A – 24 turns to arm (TTA)
  - Arm distance = TTA * Rifling * Bore dia.
  - M102
    - 24*20*105/304.8= 165 feet
  - Mk45
    - 24*25*5/12= 250 feet

Test Performed on Modified S&A

- Arming Spin test @ 1700 RPM
  - S&A with Aluminum rotor (56% decrease in mass) yielded 32% increase in arm time

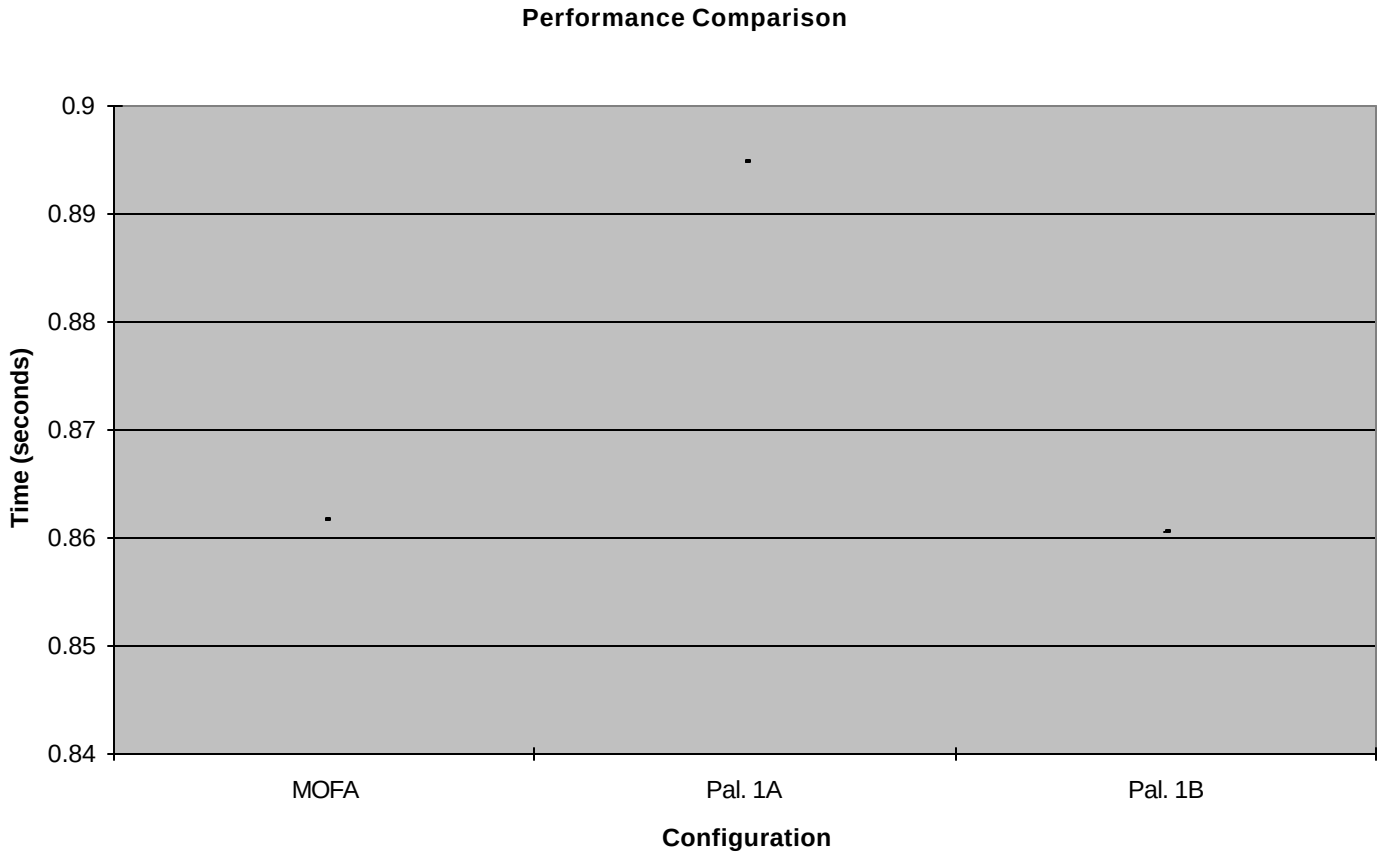
Test Performed on Modified S&A



Test Performed on Modified S&A

- Arming Spin test @ 1700 RPM (cont.)
  - S&A with modified pallet (61% increased mass) yielded 40% increase in arm time

Test Performed on Modified S&A



Test Performed on Modified S&A

- Arming Spin test @ 1700 RPM (cont.)
  - Combined effect
  - 85% increase in arming distance

Resulting Increase in Arm Time

- M782 arm time at 1700 RPM
  - 850 ms
  - 850 ms * 1.85 = 1.57 seconds
- MOFN application
  - 1.57*1700/60*25*5/12 = 463 feet (min arm)
- Meets minimum arm with some margin

Continued Test Efforts

- Efforts not completed in time for presentation
  - Detonation propagation tests with Aluminum rotor
  - Out of Line Safety

Energetic Test Results

- Out-of-line safety
  - Progressive arming
- Explosive propagation
  - Gap test (5 mil Mylar)