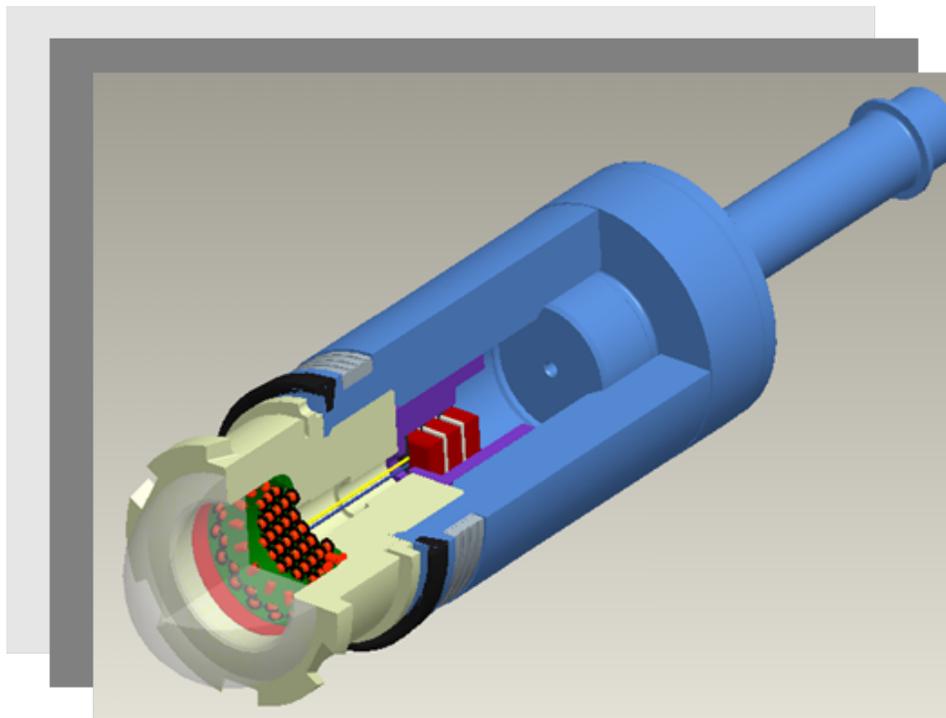


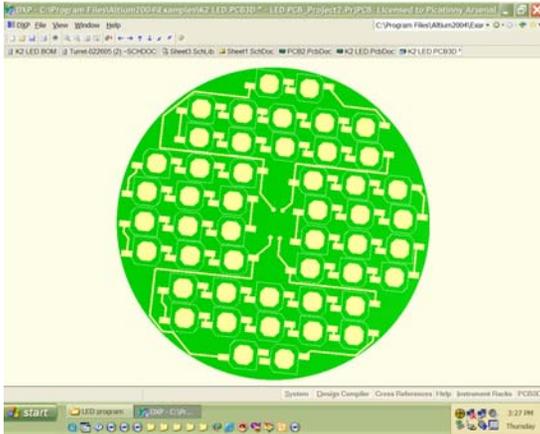
120mm Flameless Tracer



Presented by: John Kostka

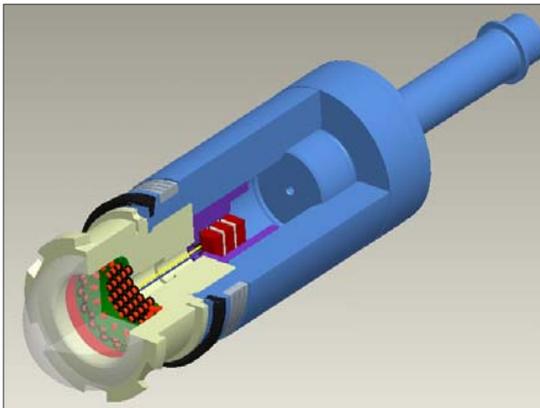
7 April 2009

Flameless Tracer Design Description



Problem Statement: The current tank ammunition is prone to causing range fires that impede training exercises, research and development tests, and Lot Acceptance Tests (LAT's). Range fires add considerable delays during training and testing.

Proposed Solution: A non-pyro tracer made of Light Emitting Diodes (LEDs) will not cause range fires and reduces the amount of energetics in the round, improving IM characteristics.



Description: The M831A1 and later the M1002 will be the test bed for this effort. An LED array will be placed in the tailcone of the M831A1 with the power supply placed into the open cavity of the body.

Current Status

⚡ 8 Design Configurations:

⚡ Red

⚡ Dark Blue

⚡ Variable Flash Rates

⚡ Blue

⚡ Yellow

⚡ 2km, 2.5km, & 3km Distances

⚡ White

⚡ Green

⚡ LED Visibility at Requirement Distance (VRD) test completed Successfully

⚡ LED Flameless Tracer in 40mm Grenade

Component Survival and Function in 40mm Grenade completed Successfully

⚡ LED Tracer Air Gun Test

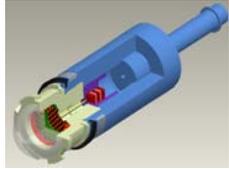
Component Survival and Function in High “G” Environment completed Successfully

⚡ LED Tracer in 120mm M831A1 Ballistic Test planed.

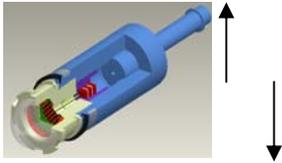
Currently working on Manufacturing hardware, electrical component testing and ballistic test scheduling.

Visibility at Required Distance (VRD) Test

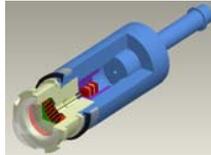
3 Km
■ ■ ■ ■ ■ ■ ■ ■



2.5 Km
■ ■ ■ ■ ■ ■ ■ ■



2 Km
■ ■ ■ ■ ■ ■ ■ ■



⚠ *Start at 2k, if successful, move to 3k, if unsuccessful, move to 2.5k.*

50 ft



⚠ *Visible to tank optics and trained observers up to 50 ft left/right of tank*

Variables:

- Distance
- Color
- Flash/Blink rate

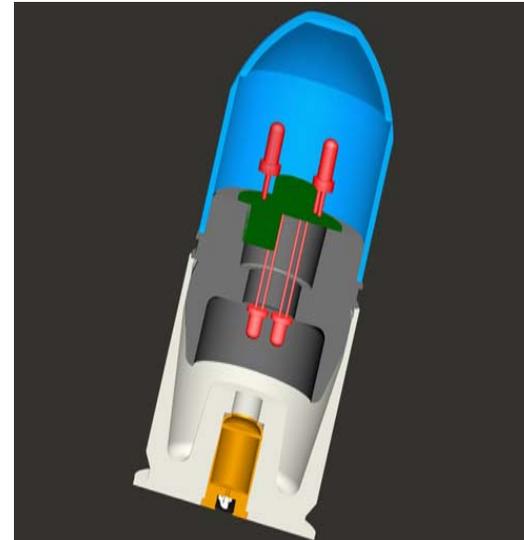
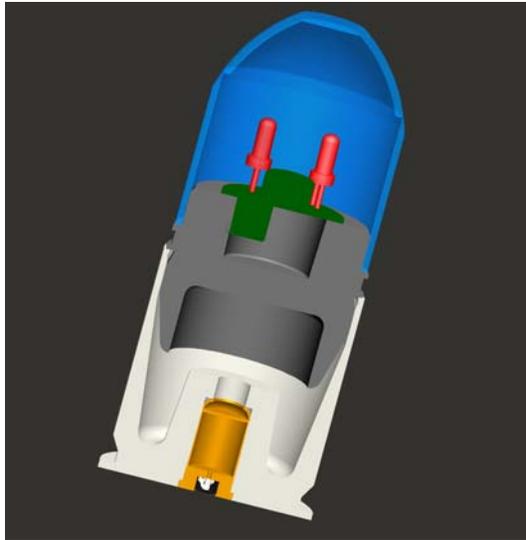
Information To Be Gathered:

- Brightness
- Intensity
- Comparison to current M831A1 tracer

Success Criteria:

- LED tracer visible to binocular aided eye at tank location and to the left/right of tank.

Flameless Tracer in 40mm Grenade Test



Information Gathered:

Visibility
Survivability
Recovered
Projectiles

Success Criteria:

Design survives
and is visible to
target

LED Tracer Air Gun Test

Components Survival and Function in High "G" Environment

Oct-14, 16 -2008

- Air gun test at Picatinny Arsenal.
- Plan three (3) tests: (25kG's, 35kG's, & 45kG's)
- Three LED arrays were tested.
- LED array and PCB board tested as a unit.
- LED function tested before and after each test.
- LED array, PCB board functioned perfectly after launch and recovery at G levels:
 - Shot 1: LED#1 24, 781G - Passed
 - Shot 2: LED#2 35,257G - Passed
 - Shot 3: LED#3 44,402G - Passed

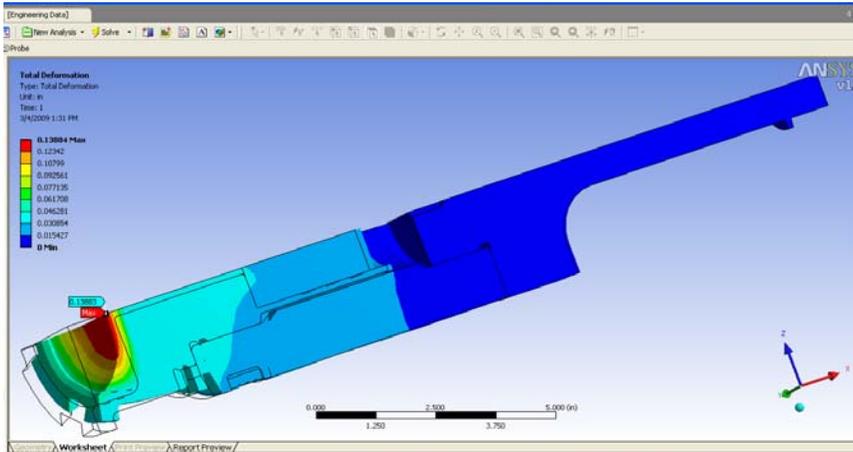


✓LED array, PCB board functioned perfectly after each launch and recovery!

Flameless Tracer Ballistic Test I

Preparatory Work

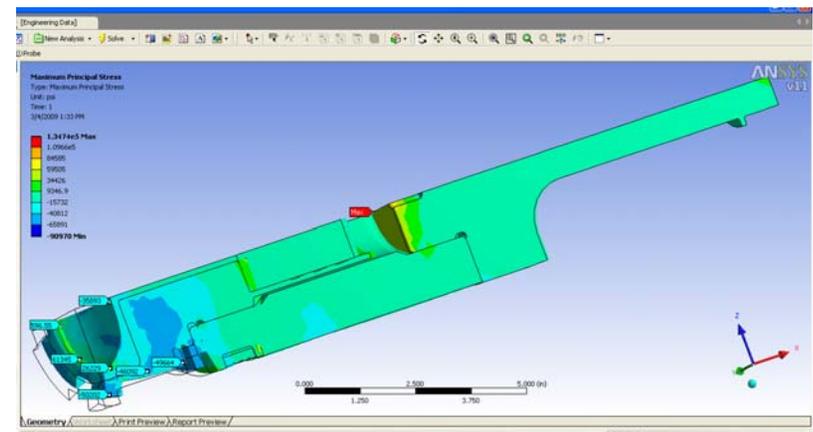
Anslys Analysis (Total Deformation)



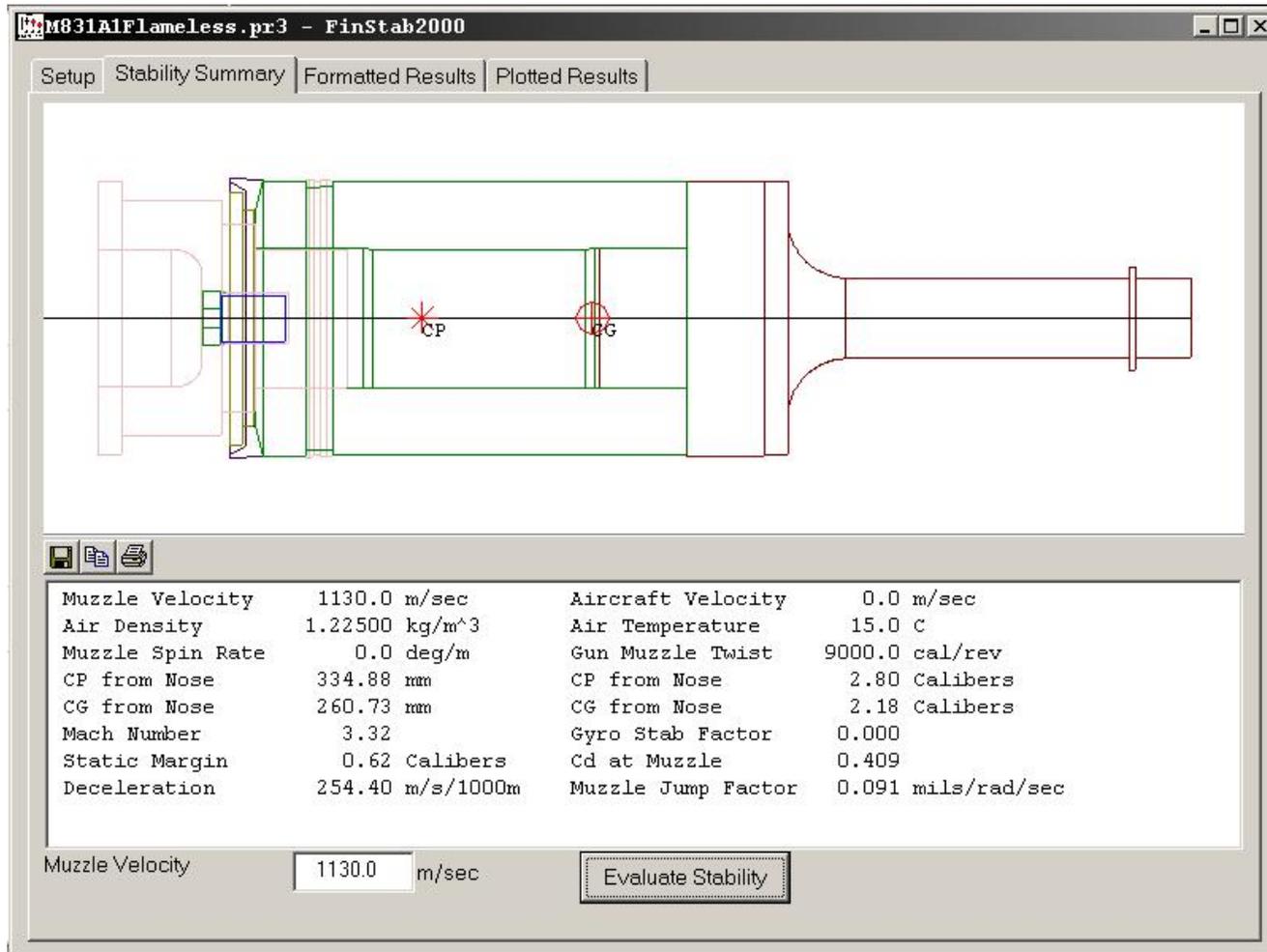
Analysis of the total deformation is less an 1/8" inch suggesting that the on board electronics should not be affected by gun launch.

Analysis of maximum principal stress indicates that the modified projectile should survive gun launch.

Anslys Analysis (Maximum Principal Stress)

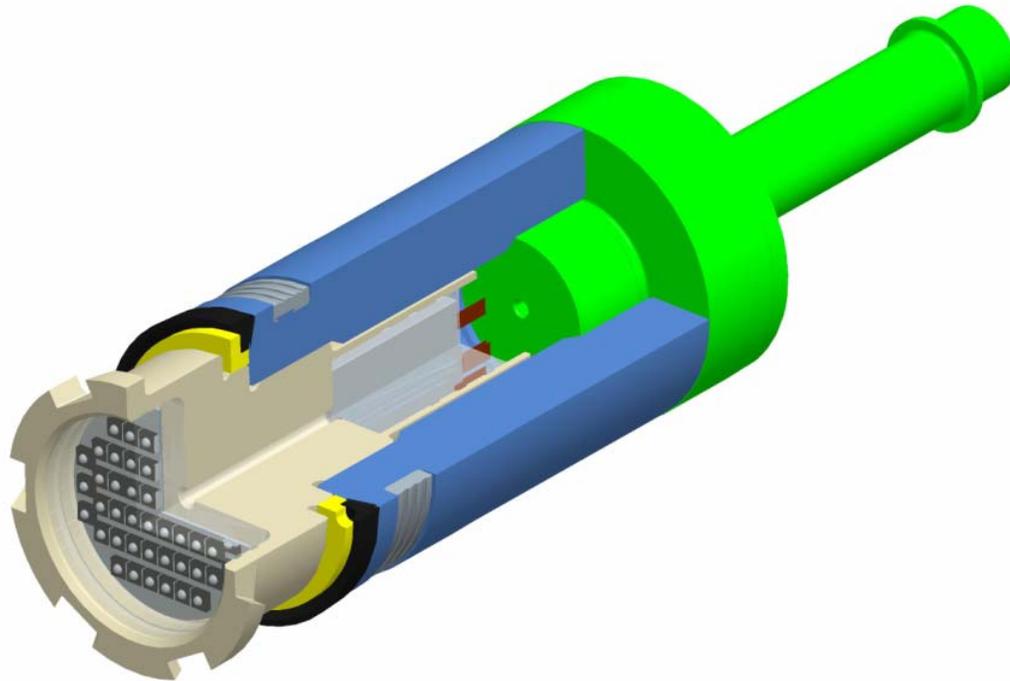


Prodas Analysis



Stable within with range 1143 m/s - 600 m/s MV

Flameless Tracer Ballistic Test I



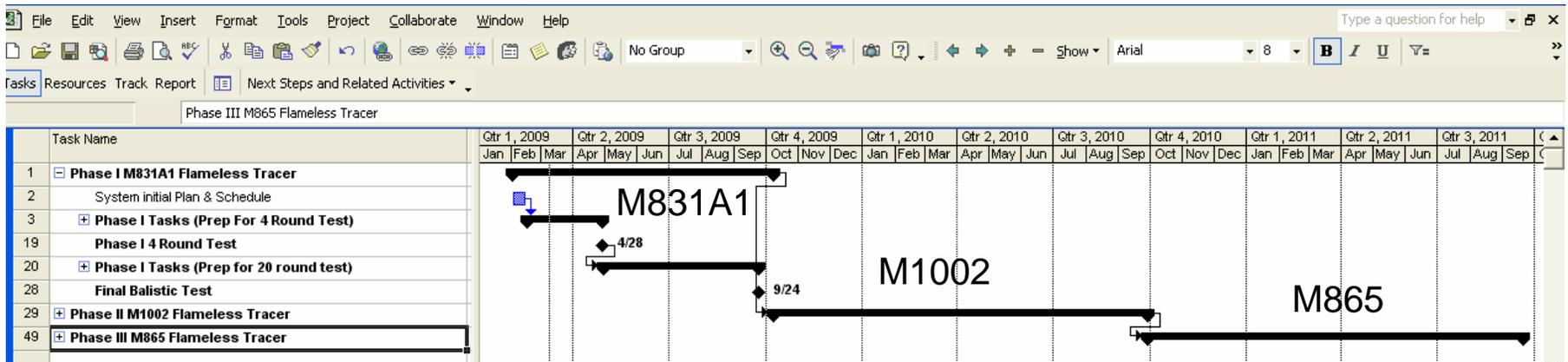
Information to Gather:

Video tracking to 2km
Hadland photos at 7m & 15m
Visibility naked eye & binocular
Survivability
Recovered Projectiles
and other typical LAT data.

Success Criteria:

The design survives setback
and is visible to target
Exterior ballistics are unaffected
The test is completed
without incident

Program Schedule



- Proof of concept designing and testing - complete
- Phase 1a testing in the M831A1 schedule for May 2009
- Phase 1b strength of design testing scheduled Oct 2009
- Phase 2 M1002 flameless tracer completion Oct 2010
- Phase 3 M865 flameless tracer completion Sept 2011

Future Possibilities

- ⤴ Link Flameless Tracer To M1002 Nose Switch:
 - ⤴ Use different color for Ground vs. Air setting
- ⤴ Use Flameless Tracer To Simulate Air Burst M1002
 - ⤴ Use different blink pattern to simulate Air Burst
- ⤴ Replace Batteries With Capacitors
 - ⤴ Charge Capacitors through data link

Issues/Concerns

⚡ M1002's 3km visibility range requirement is the longest of any training round.

Resolution: Enough power will be included for the ~4 seconds of flight. Brighter LEDs are expected on the market this year.

⚡ The M1A2 series tank's CITV is a thermal optic which may not pick up the LEDs in flight.

Resolution: An IR emitting LED can be added to the array, or the CITV might pick up the forward edge heating of the projectile in flight.

⚡ It will be a challenge to fit the LED array and battery/capacitor into the M865's fin configuration.

Resolution: The current tracer cup and fin design may be modified to accommodate the LEDs. Less power will be required for the M865's shorter flight time to target. Future efforts will shrink the size of components.

⚡ Current tank training round tracer costs \$10-\$12.

Resolution: Future efforts will be required to reduce the cost of any design created by this effort.