Alliant Ammunition Systems Company LLC

Advanced Medium Caliber HEI Ammunition
-Mechanically Fuzed and Delay Initiated –

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ITARS 125.4(b)(13) DFOISR 02-S-1131
Outline

• Project Objective
• Design Approach
• Progress Summary
  – 30mm Results
  – 20mm Results
• Conclusion
Different Targets Require Different Ammunition Solutions

Project Objective

- Develop a medium caliber ammunition product approach (multiple rounds) that would:
  - Be effective against dismounted troops
  - Be effective against light armor
  - Function reliably
    - Extended ranges (600 fps impact velocity)
    - Shallow impact angles (70 degrees)
  - Be compatible with multiple platforms
  - Utilize current ATK production equipment and processes
The Solution is Called ZAP

- ZAP-Super Quick is a mechanical nose fuze high explosive round
- ZAP-Delay is a mechanical nose fuze high explosive round with a warhead initiation delay built in
ZAP Meets The Project Objectives

• ZAP rounds are ballistically matched allowing them to be mixed in the feed system with no burden placed on the fire control system
  – ZAP is also matched to certain inventory rounds

• ZAP rounds are fully compatible with a variety of platforms
  – 20mm F-16, F-18, Comanche
  – 25mm Bradley
  – 30mm AAAV, A-10

• ZAP’s mechanical nose fuze couples high reliability with low cost
  – Identical fuze whether super quick function or delay function
ZAP Low Risk Design Approach Ensures Producibility

• Design mechanically fuzed, delay initiated high explosive rounds in 20, 25 and 30mm calibers
  – Place delay in projectile, not in fuze
    • Eliminate expensive fuze development and qualification effort
    • Leverage current fuze production capability

• Maintain current propulsion and ignition system for all calibers
  – No new propellant development
  – No change in primers or ignition system
  – No change in cartridge case

• All designs compatible with current production/LAP equipment and processes
ZAP Delay Function Easily Achieved

- Incendiary Material
- Rotating Band
- Pyrotechnic Delay Element
  - Placed between high explosive and fuze in this location
- Mechanical Fuze
- Tracer Seal
- Tracer
- High Explosive
- Projectile Body
ZAP Ammunition Progress Continues

Last year demonstrated delay approach in 20mm, 25mm and 30mm

This year:

- Designed, fabricated and tested low drag mechanical fuze
- Designed fabricated and tested enhanced 30mm projectile
  - Hardened steel body
  - Improved aerodynamic shape
    - Matches current 30mm rounds for AAAV
- Designed fabricated and tested enhanced 20mm projectile
  - Hardened steel body
  - Aeroballistics matched to PGU-28
  - Met PGU-28 performance requirements
    - Initiation delay
    - Penetration
Mechanical Fuze Provides Long Range Function

• Improve aerodynamic performance of fuze i.e. reduce drag without altering performance and producibility

• Lengthened fuze for more aerodynamic shape
  – Maintained functionality at low velocity, high obliquity impacts
    • Demonstrated in 30mm at 600fps & 70 degrees
  – Minor impact on production since probe and probe cap are some of last items assembled

• Resulting fuze maintains low cost performance and utilizes design already qualified for production
  – Dual environment safety (MIL-STD-1316)
ATK-151LD Fuze Allows For MIL-STD-1316 Compliance

ATK-151LD PD Fuze for 20mm - 30mm ZAP Ammunition
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Ammunition Tested Against Plate Arrays and Armor

- Testing has been conducted against both plate arrays and armor plate targets in 20mm, 25mm and 30mm

- Multi-plate PGU-32 aluminum plate target array chosen as evaluation vehicle
  - Allows for meaningful data comparison against other multipurpose rounds
  - Drawback is array is not representative of real targets
    - Cannot quantify damage against specific targets of interest based on results
Standard Plate Array Provides for Meaningful Data Comparison

- PGU-32 plate array
  - 10 Aluminum plates
  - Plates spaced 8 inches apart
  - Each plate 48 inches by 48 inches square
  - First plate .080 inches thick, remaining plates .040 inches thick

Advanced HEI Plate Array

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<th>Plate #6</th>
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ZAP Delay Function Demonstrated in 30mm

Time = 0

Time = 3.3 msec

Time = 9.9 msec
Large Body Fragments Provide Anti-Materiel Capability

- 30mm projectile
30mm ZAP Test Demonstrates Performance Differences

Super Quick Explosive Initiation

Plate #1  Plate #2  Plate #3  Plate #4

Delayed Explosive Initiation

Plate #1  Plate #2  Plate #3  Plate #4
30mm ZAP Test Demonstrates Performance Differences

Super Quick Explosive Initiation

Plate #6
Plate #8
Plate #10
Celotex Bundle

Plate #6
Plate #8
Plate #10
Celotex Bundle

Delayed Explosive Initiation

Celotex Bundle
Celotex Bundle

Plate #6
Plate #8
Plate #10
Celotex Bundle

Plate #6
Plate #8
Plate #10
Celotex Bundle

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Low Drag 30mm Design Complete and Tested

- Compatible with Mk 44 and GAU-8/A cannons
- ~50 grams of explosive/incendiary material
- Penetration Test (SAPHEI) conducted against 10mm RHA @ 60 degrees obliquity supports target defeat in excess of 1300 meters
- Long range impact (~6000 meters) verified
- Demonstrated tracer burn time exceeds 3500 meters
20mm ZAP Projectiles Designed, Fabricated and Tested

- 20mm ZAP ballistically matched to PGU-27

ZAP-Super Quick (HEI-T)
ZAP-Delay (SAPHEI-T)
PGU-27 (TP)

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20mm ZAP Delay Armor Penetration Exceeds PGU-28 Spec.

PGU-28 Requirement:

- .375” RHA @ 45°
- PBL=2786 fps

20mm ZAP – Delay PBL of 2224 fps significantly better than PGU-28 penetration requirement

2215 fps Impact Velocity

2872 fps Impact Velocity
20mm ZAP Delay Meets PGU-28 Fragmentation Spec.

Multi-Plate Array Test
- Delay function demonstrated -

Shot #3
Plate #1  Plate #2  Plate #3  Plate #4
Plate #5  Plate #6  Plate #7  Plate #8

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20mm ZAP Delay Array Test Results

Multi-Plate Array Test
- Delay function demonstrated -

Plate #9

- PGU-28 Requirement = not less than 8 penetrations
- ZAP Results = 11 penetrations

Plate #10

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Extensive Testing Conducted in 20mm, 25mm and 30mm

**ZAP Delay Ammunition**
- Concept demonstration
- Armor Penetration
- Delay mechanism at temperature extremes (-54°C to +71°C)
- Energetic consolidation investigation

**ZAP Super Quick Ammunition**
- Fuze/Projectile function
  - No arm
  - All arm
  - Low velocity impact
  - High graze angle
• ATK has developed a family of mechanically fuzed, super quick or delay initiated high explosive cartridge in 30mm, 25mm and 20mm calibers
  – Allows the customer to have mechanically fuzed rounds with super quick initiation, delay initiation or a mix of both
    • All with excellent performance at high obliquity and/or long range impact function

• Effectiveness of ATK projectiles are not range sensitive
  – Chemical not KE energy source
  – Fuze designed to function at low velocity/high obliquity impacts

• High volume production lines exist and in use
  – Low cost solutions to meet our customers needs
ZAP is Ready - Today

- 20mm ZAP
- 30mm ZAP

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30mm ZAP