# Alliant Ammunition Systems Company LLC

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

20mm ZAP


30mm ZAP

**Presented by**
**Mr. Brian Tasson**

# 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

**20mm ZAP**


**30mm ZAP**

# ZAP Meets The Project Objectives

- ZAP rounds are ballisticlly 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

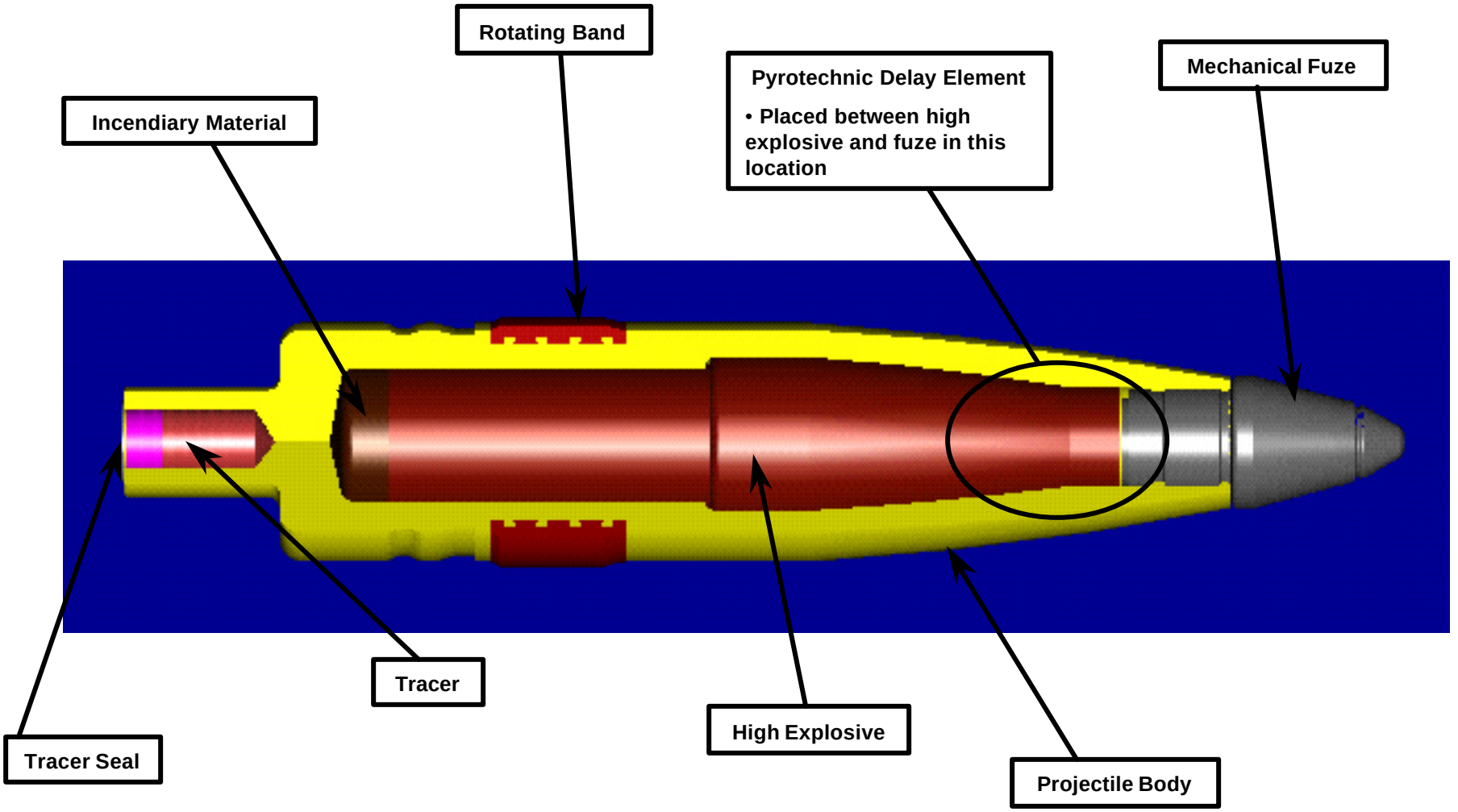
- ZAP rounds are fully compatible with a variety of platforms
  - 20mm F-16, F-18, Comanche
  - 25mm Bradley
  - 30mm AAAV, A-10

- 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



# 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

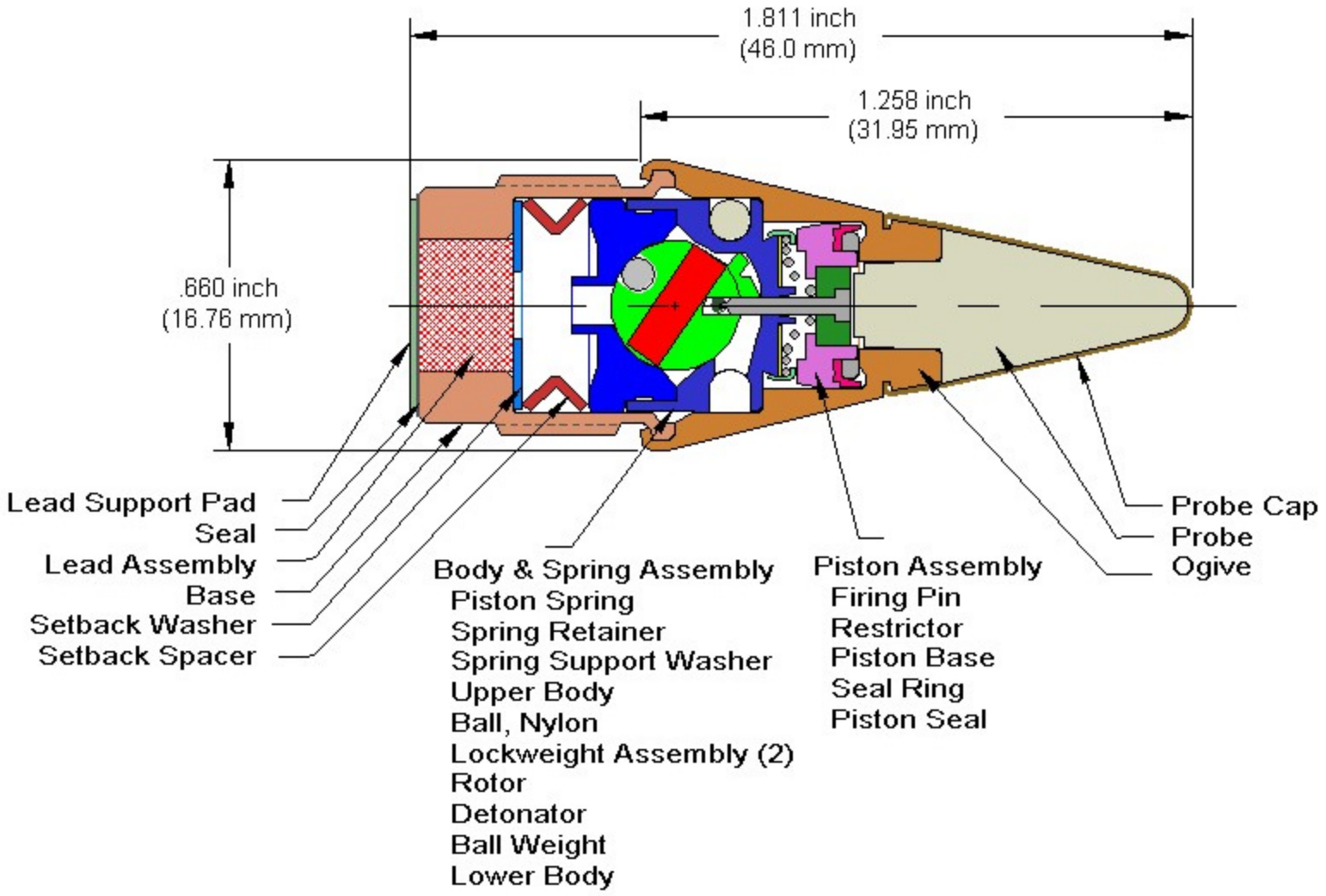
# Mechanical Fuze Provides Long Range Function

- 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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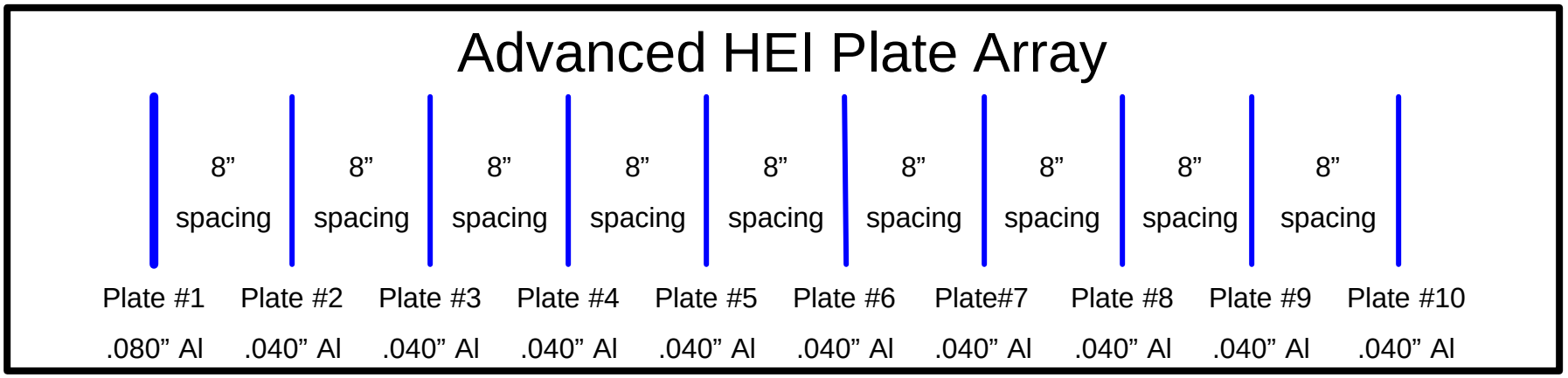
# Ammunition Tested Against Plate Arrays and Armor

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

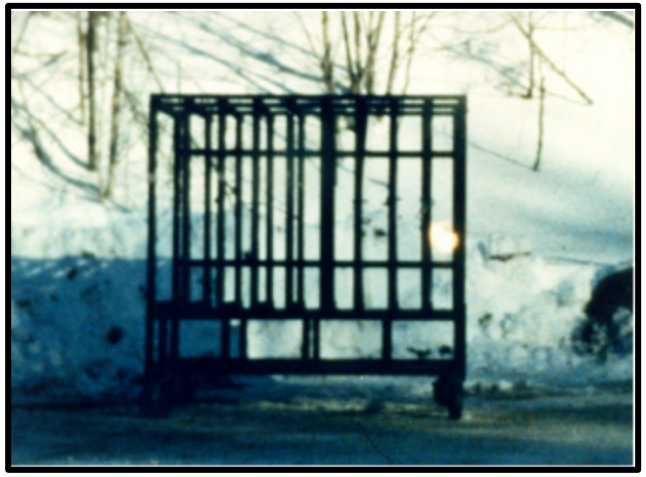
- Multi-plate PGU-32 aluminum plate target array chosen as evaluation vehicle
  - Allows for meaningful data comparison against other multipurpose rounds
  - Drawback is array is not representative of real targets
    - Cannot quantify damage against specific targets of interest based on results

# 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



# ZAP Delay Function Demonstrated in 30mm



Time = 0

Time = 3.3 msec

Time = 9.9 msec





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# Large Body Fragments Provide Anti-Materiel Capability

- 30mm projectile

# 30mm ZAP Test Demonstrates Performance Differences

## Super Quick Explosive Initiation

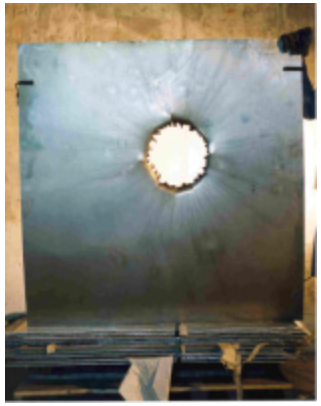

Plate #1

Plate #2

Plate #3

Plate #4

## Delayed Explosive Initiation

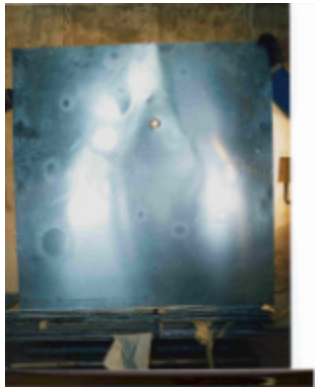

Plate #1

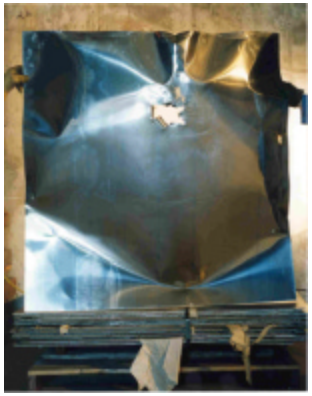

Plate #2

Plate #3

Plate #4

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# 30mm ZAP Test Demonstrates Performance Differences

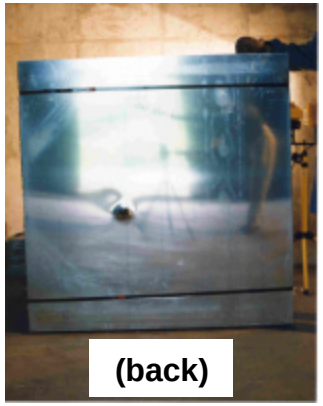
## Super Quick Explosive Initiation

Plate #6

Plate #8

Plate #10


Celotex Bundle




Celotex Bundle

## Delayed Explosive Initiation

Plate #6

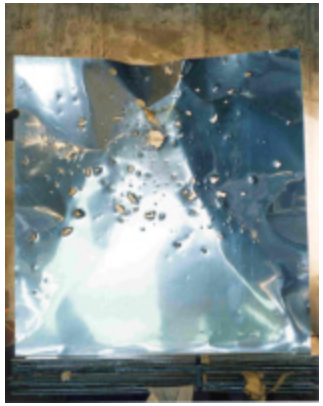


Plate #8

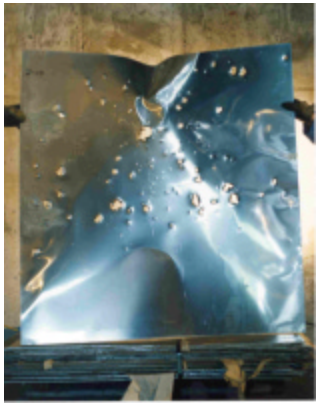
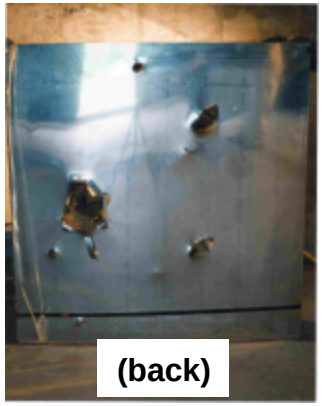


Plate #10


Celotex Bundle




Celotex Bundle

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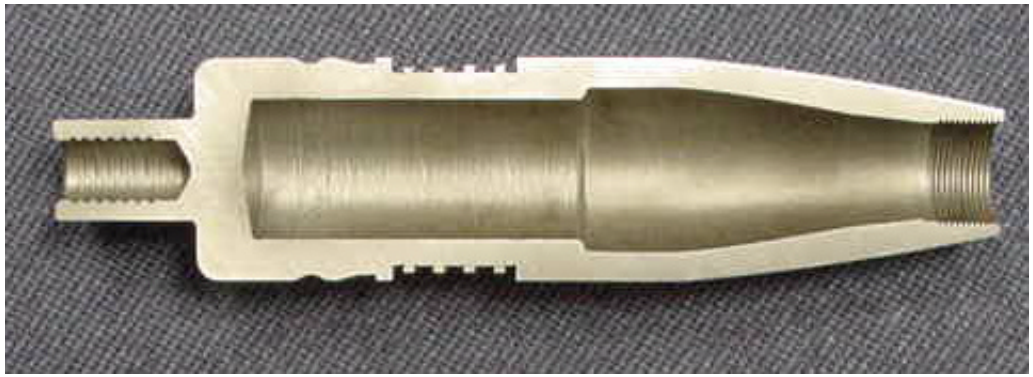
# Low Drag 30mm Design Complete and Tested


- 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)**

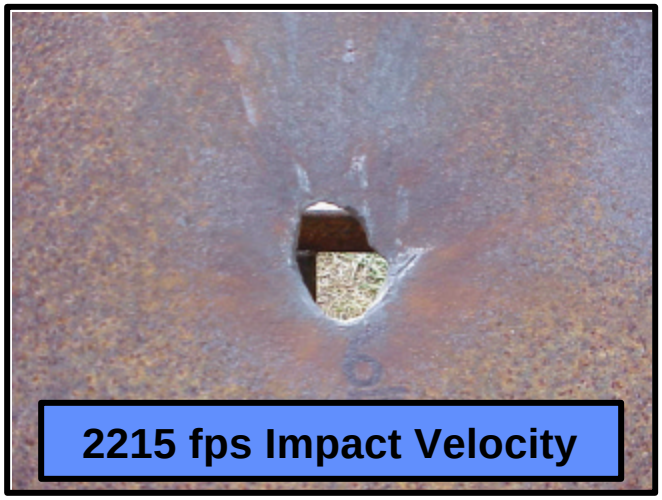
# 20mm ZAP Delay Armor Penetration Exceeds PGU-28 Spec.

PGU-28 Requirement:

.375” RHA @ 45$^{o}$

PBL=2786 fps

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




**2872 fps Impact Velocity**


# 20mm ZAP Delay Meets PGU-28 Fragmentation Spec.

## Multi-Plate Array Test
## - Delay function demonstrated -

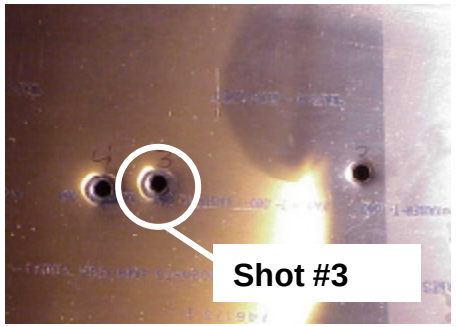



Plate #1

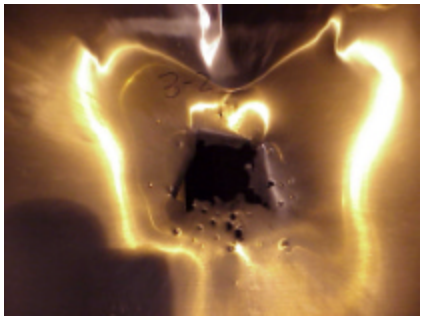
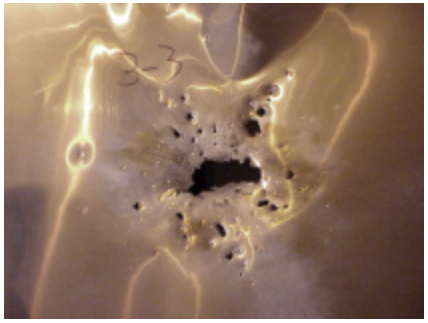


Plate #2



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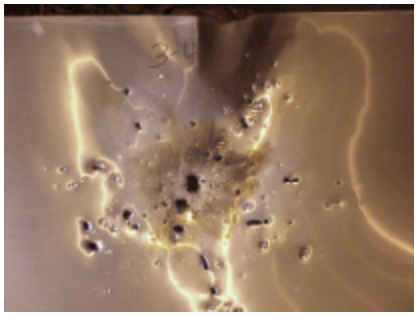

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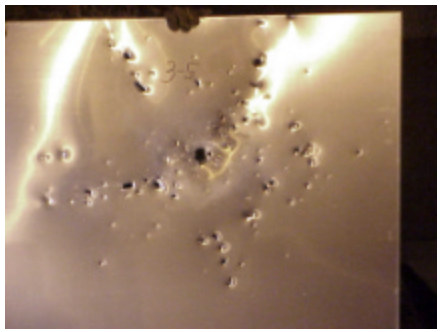

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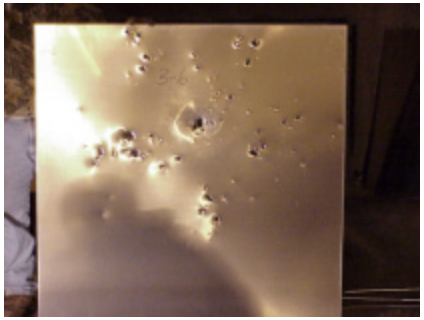
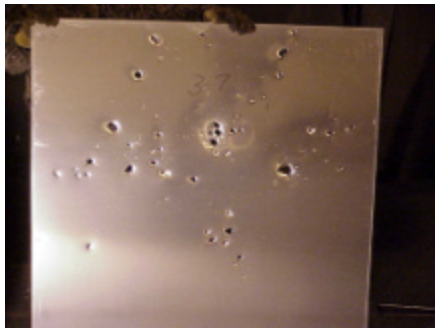


Plate #6



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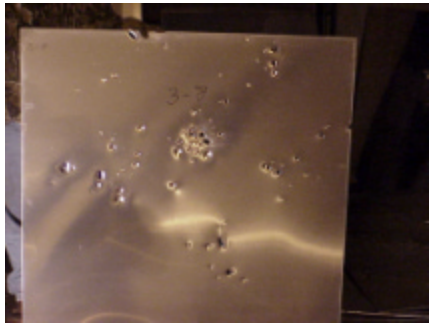

Plate #8

# 20mm ZAP Delay Array Test Results

**Multi-Plate Array Test**

**- Delay function demonstrated -**

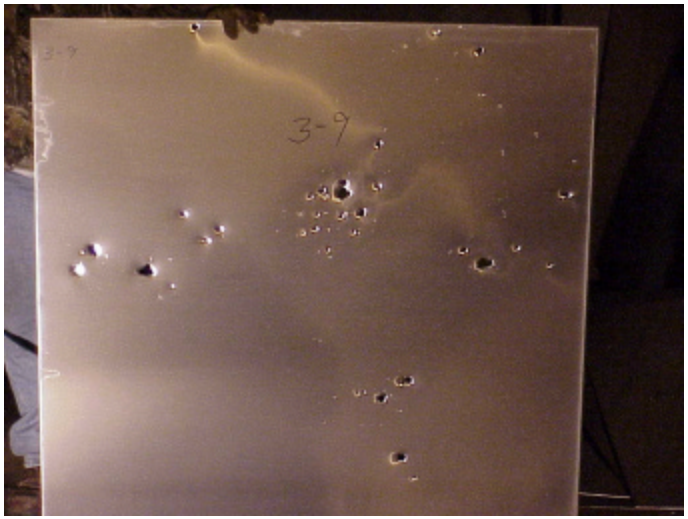


**Plate #9**

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

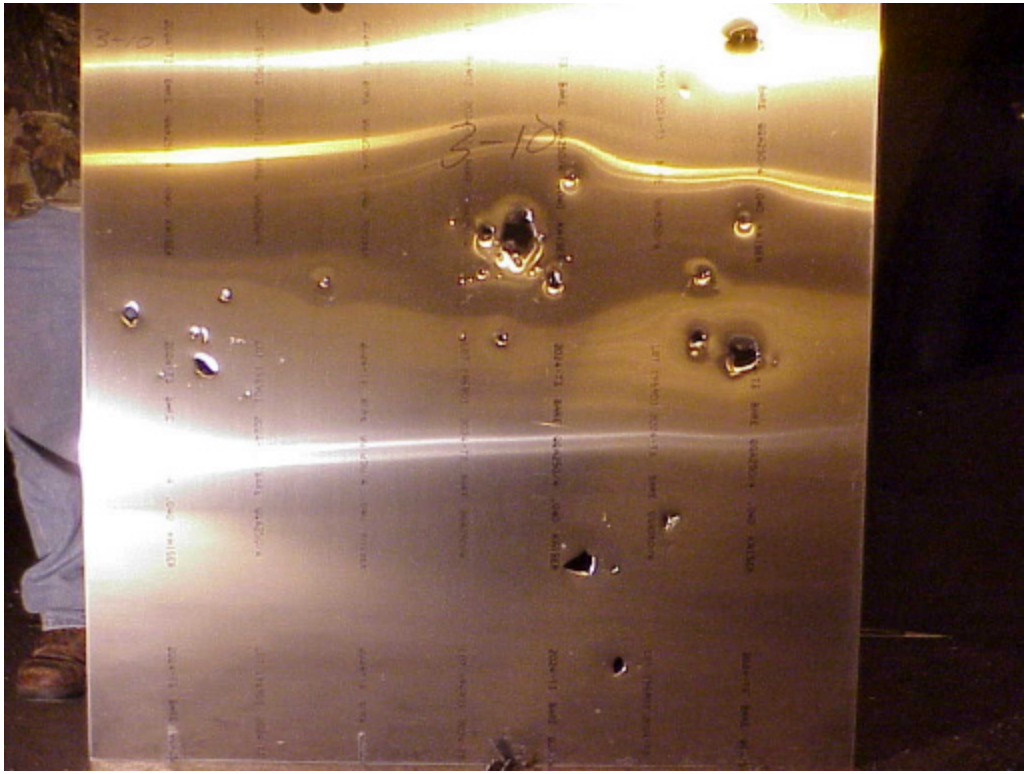


**Plate #10**





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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 The Ammunition Solution

- 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**

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**30mm ZAP**