Alliant Ammunition Systems Company LLC

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

Presented by Mr. Brian Tasson

Outline

- Background
- Product Description
  - Mechanical Fuze versus Chemical Initiation
- Design Approach
- Test Results
- Low Drag Mechanical Fuze Development
- Additional Analysis
- Conclusion

Mechanically Fuzed, Delay Initiated - Why?

AAAV Ammunition Evaluation

- Both conventional high explosive and multipurpose ammunition evaluated
- Conventional HEI rounds performed well against dismounted troops but had limited effectiveness against light armor targets
  - Super quick fuze function prevented projectile from entering target before function
- Multipurpose rounds performed well against light armor but not against dismounted troops
  - Function delay and low fragment count
- AAAV solution is to mix both types of rounds in belt in a 1 to 1 ratio

Mechanically Fuzed, Delay Initiated - Why?

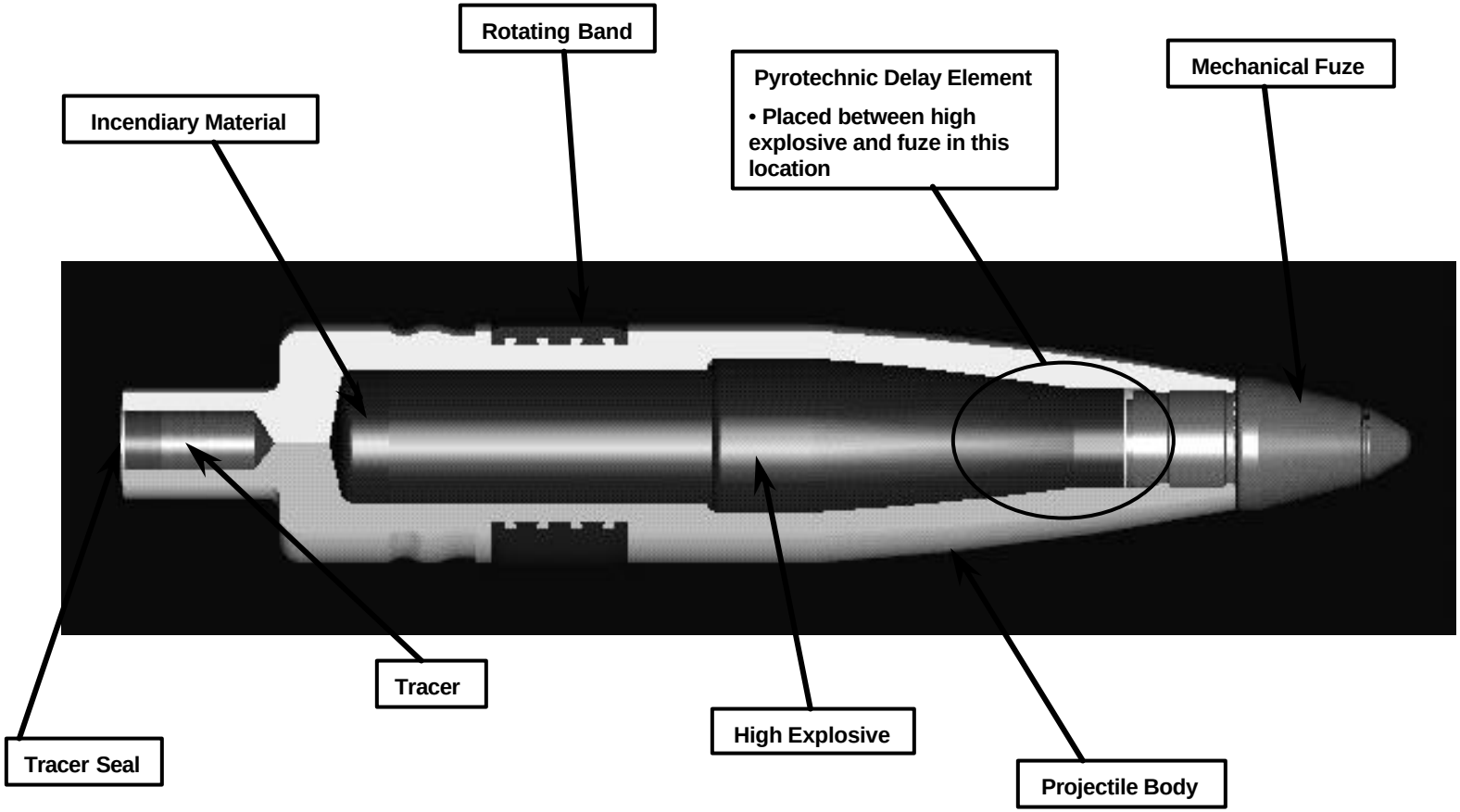
AAAV Ammunition Evaluation

- Multipurpose function issues at low impact angles observed
  - Ground to ground target
    - 4 of 8 failed to function at 1000 meters
    - 3 of 10 failed to function at 2000 meters

- ATK rounds with mechanical fuze (FMU-151) achieved 100% function at all ranges
  - 1000 to 6800 meters

- Logical solution is to combine mechanical fuze with an initiation delay
  - This approach eliminates battlefield contamination from duds
  - Mechanical fuze can incorporate a self destruct feature if desired
  - Body can be either hardened for penetration or left as is

Mechanically Fuzed, Delay Initiated HEI - 30mm Design



Mechanical Fuze (PGU-38) versus Chemical Initiation (PGU-28)

Attribute	FMU-151 Fuze	Chemical Initiation
Safety Specification	MIL-STD-1316	MIL-STD-1466
Out of Line Safety	Yes	No
Arming Criteria		
- No arm	10 meters	In-bore
- All Arm	200 meters	In-bore
Impact Sensitivity		
- Terminal Velocity	600 fps	No requirement
- Graze	70 degrees	No requirement

Design Approach

- 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

Test and Evaluation

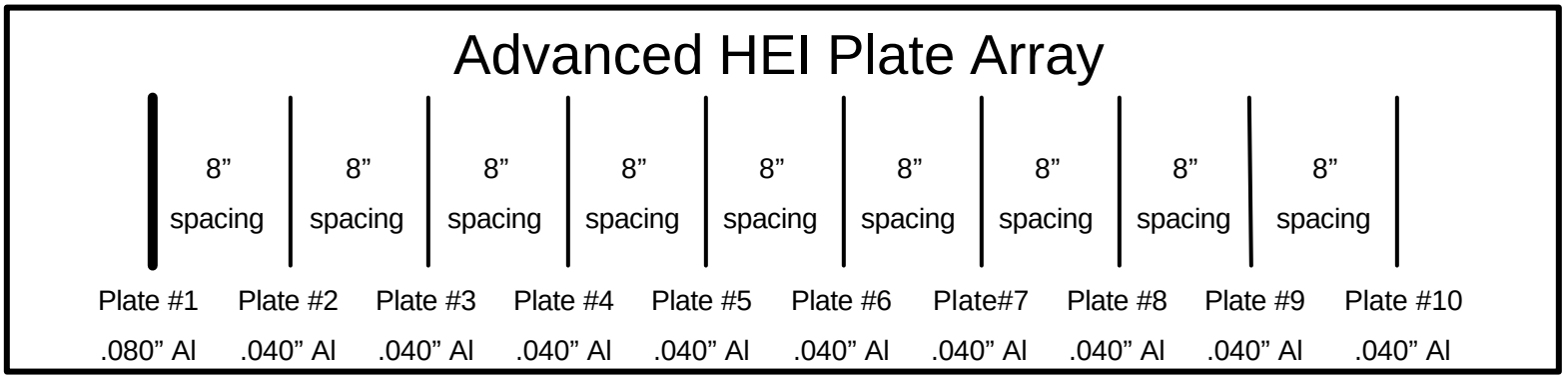
- Testing has/will be conducted against both plate arrays and armor plate targets

- 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

- Additional testing planned against armor targets to quantify penetration capability

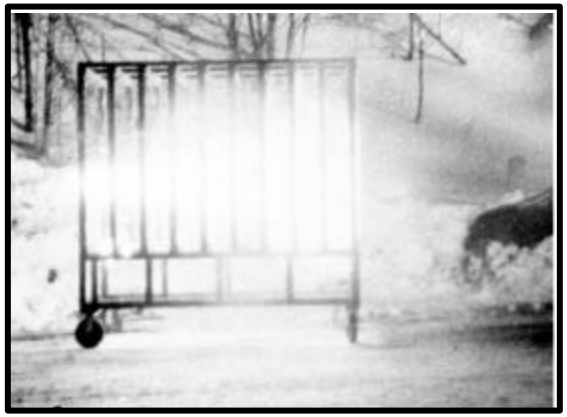
Test and Evaluation Plate Array

- 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



30mm Projectile Function (initiation between 1st & 2nd plate)

Time = 0



Time = 3.3 msec

Time = 9.9 msec

30mm Projectile Function (concluded)

Time = 16.5 msec

Time = 23.1 msec

Time = 36.3 msec

Recovered Body fragments

- 30mm projectile

Advanced 30mm HEI Test Results (complete array)

Standard Explosive Initiation (Super Quick)

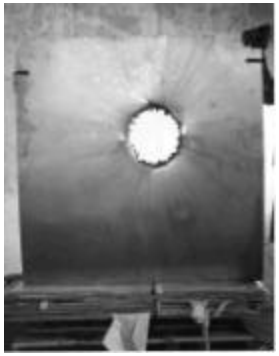


Plate #1

Plate #2

Plate #3

Plate #4

Delayed Explosive Initiation

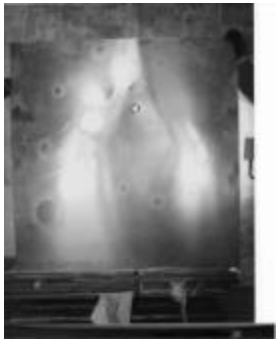


Plate #1

Plate #2

Plate #3

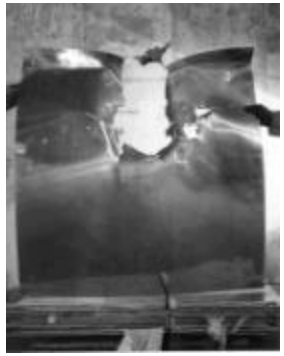


Plate #4

Advanced 30mm HEI Test Results (concluded)

Standard Explosive Initiation (Super Quick)

Plate #6

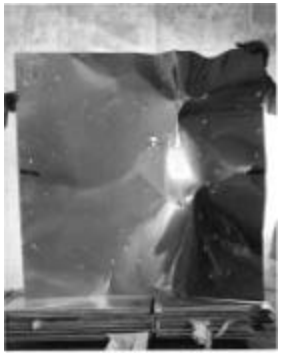


Plate #8

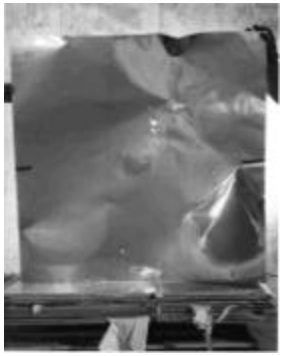
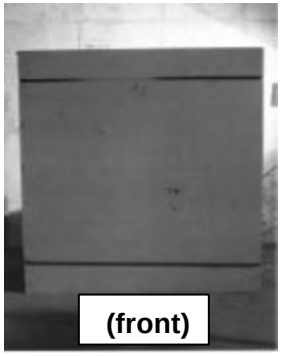


Plate #10



Celotex Bundle

Celotex Bundle

Delayed Explosive Initiation

Plate #6

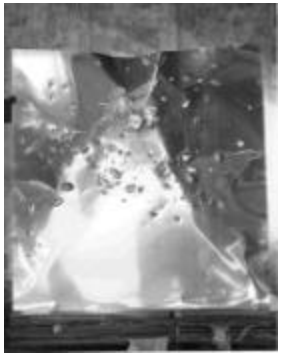


Plate #8

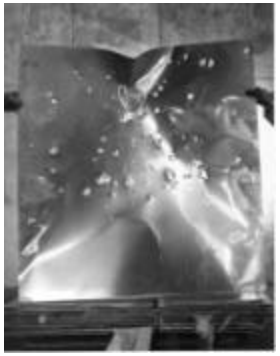
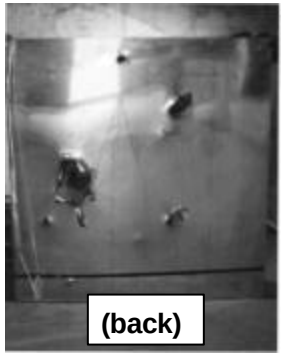


Plate #10

Celotex Bundle



Celotex Bundle

Advanced 25mm HEI Test Results (partial array)

Standard Explosive Initiation (Super Quick)

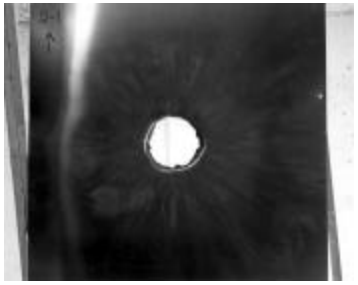


Plate #1

Plate #2

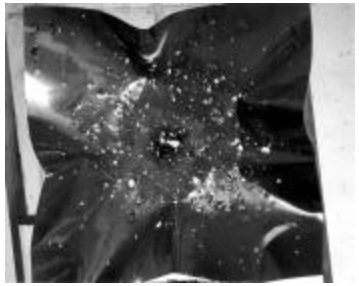


Plate #3

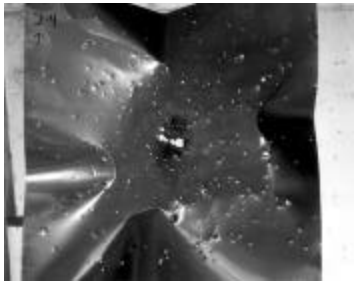


Plate #4

Delayed Explosive Initiation

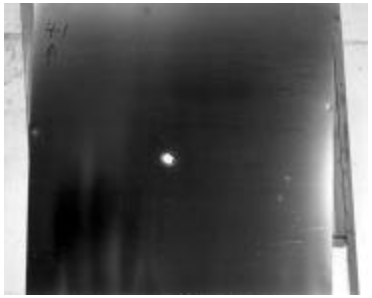


Plate #1

Plate #2

Plate #3

Plate #4

Advanced 20mm HEI Test Results (complete array)

Delayed Explosive Initiation

Plate #1

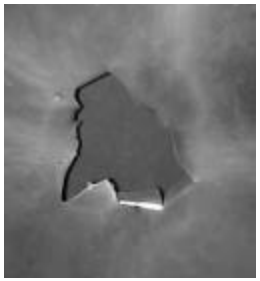


Plate #2

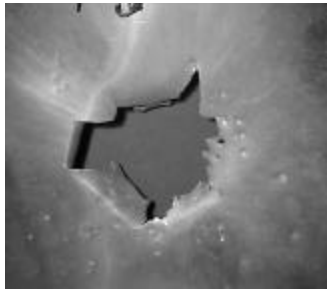


Plate #3

Plate #4

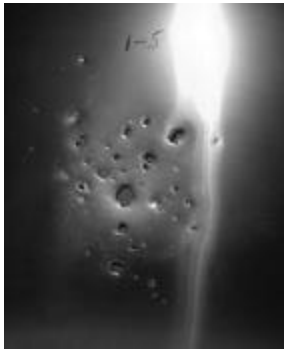


Plate #5

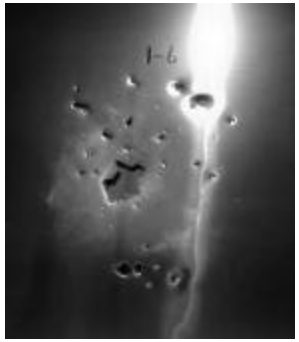


Plate #6

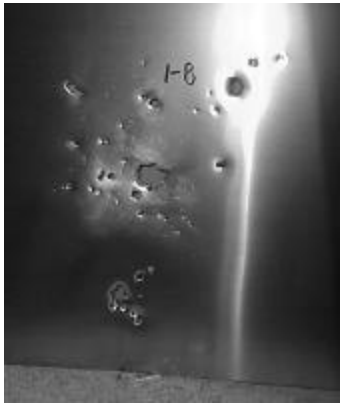


Plate #8

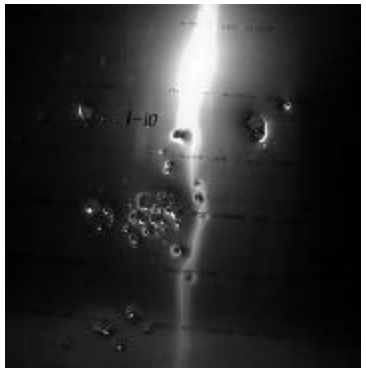


Plate #10

Low Drag Fuze Rationale

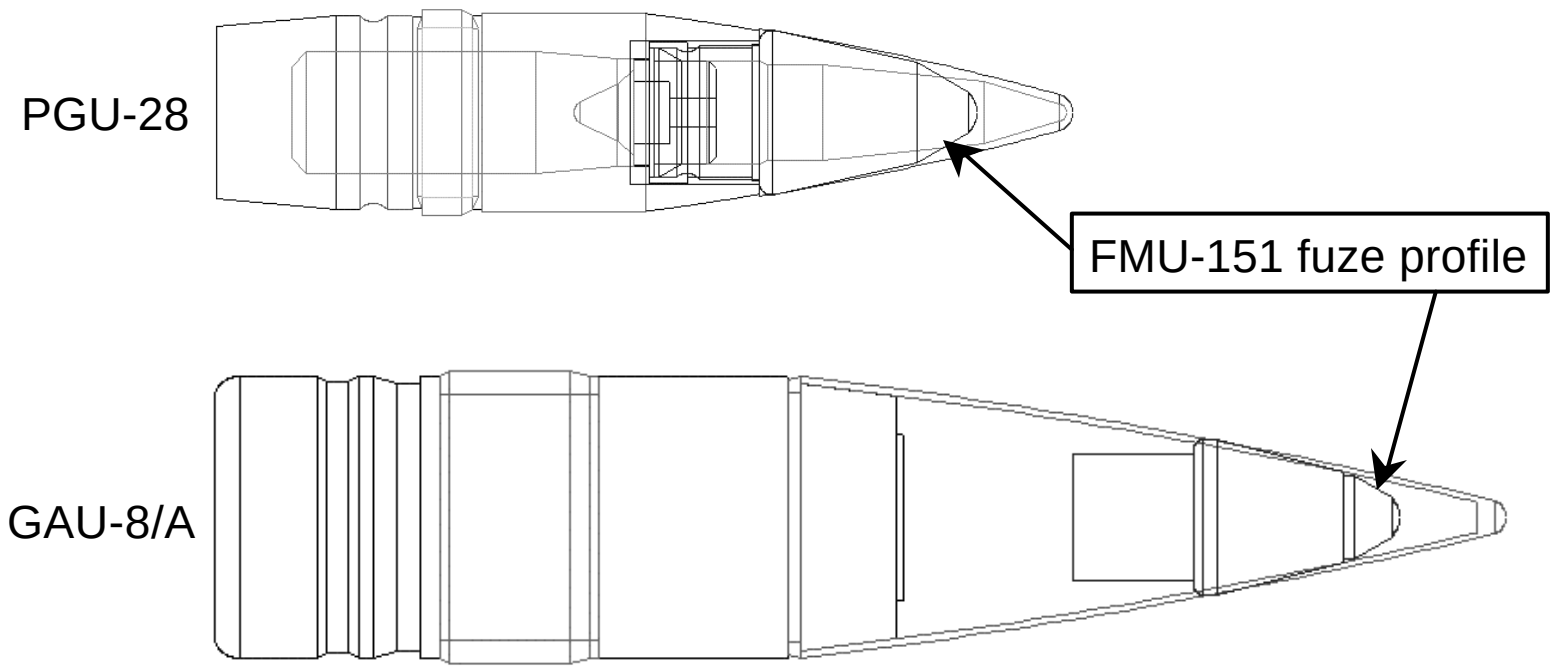
- Initial test results demonstrated feasibility of concept

- FMU-151 fuze provided excellent warhead initiation performance across a wide range of target encounters

- FMU-151 fuze did not offer a low drag solution
  - Lengthened time of flight
    - Decreased probability of hit
  - Impacted the design of a common ballistic 30mm family

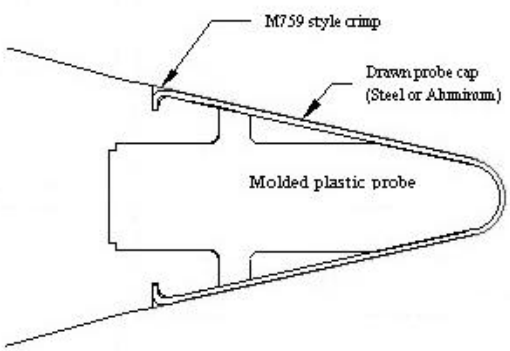
Projectile/Fuze Comparisons – PGU-28 and GAU-8/A

- FMU-151 fuze ogive shape increases drag for both projectiles



FMU-151 Fuze Modification to Low Drag Version

- FMU-151 has shorter ogive
  - Minor fuze modification will provide a profile/ballistic match
    - Fuze body, probe and different probe cap are only affected fuze parts



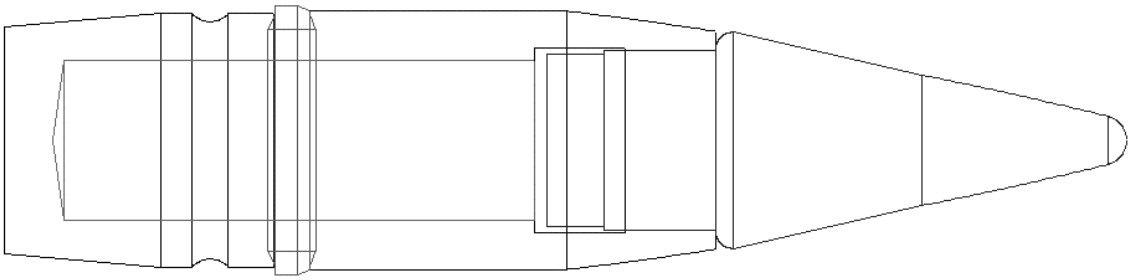
Modified FMU-151

FMU-151

ATK 20mm Mechanical Fuze SAPHEI

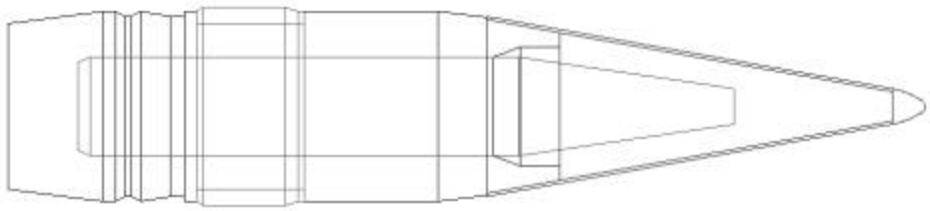
- Identical projectile envelope and weight as PGU-28
  - Aerodynamic (ballistic) match
  - Same propellant and charge weight

- Same sintered iron rotating band as PGU-27

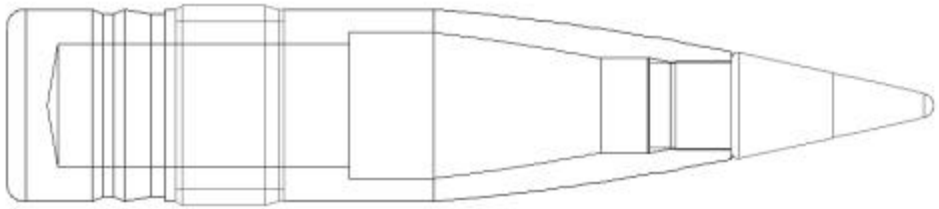


ATK Ballistically Matched Family of Ammunition

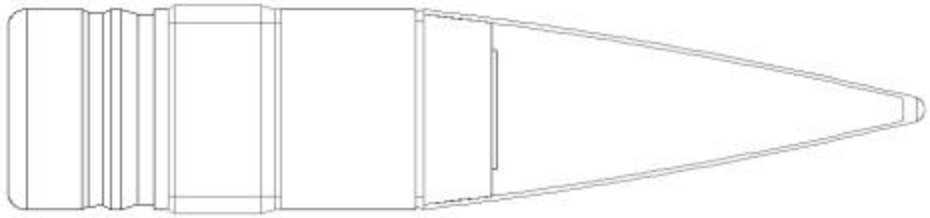
Tungsten Armor Piercing Projectile



High Explosive Incendiary Projectile (super quick or delay)



Target Practice Projectile



Conclusion

- ATK has developed a mechanically fuzed, 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