NDIA Fuze Conference

Kansas City, Missouri

May 11-13, 2010

RDECOM

Malcolm Baldrige National Quality Award 2007 Award Recipient

Fuze Technology Integration (FTI) Improved 30 mm

ARMAMENT RESEARCH, DEVELOPMENT AND ENGINEERING CENTER PICATINNY ARSENAL, NJ

TECHNOLOGY DRIVEN. WARFIGHTER FOCUSED.

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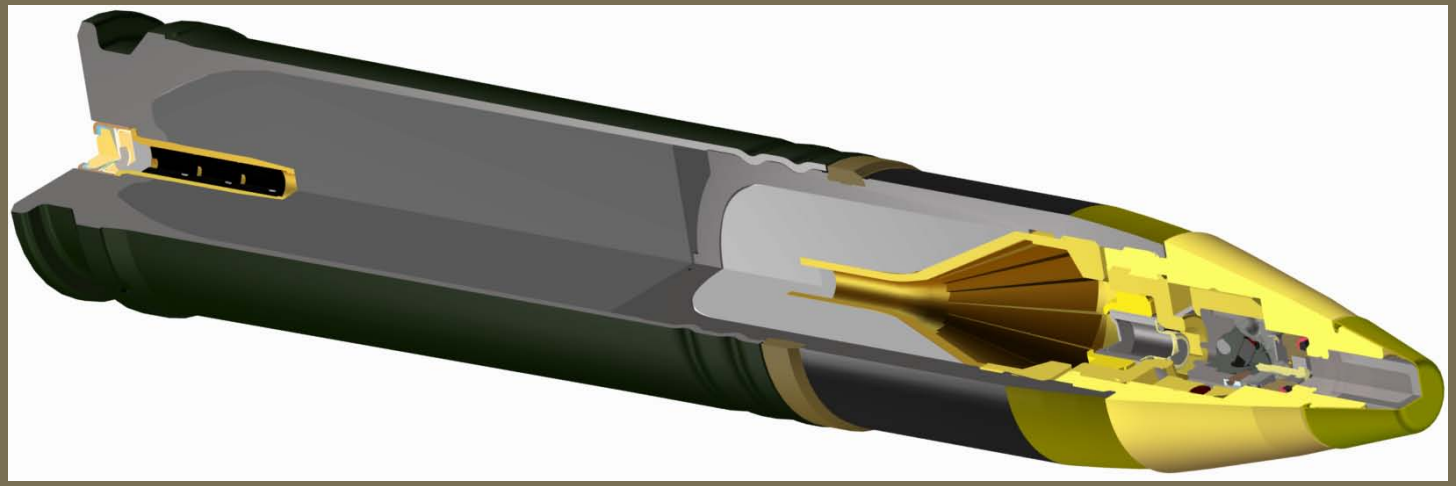
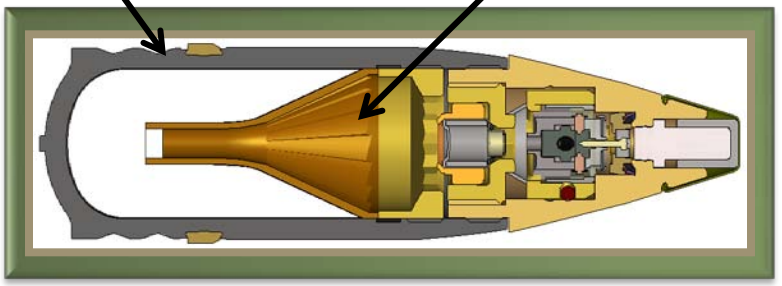
M759 Fuze

- The M759 is a Point Detonating Dual Function Fuze
  - Functional modes are impact and inertial
- The M759 Fuze is used on the M789 High Explosive Dual Purpose cartridge



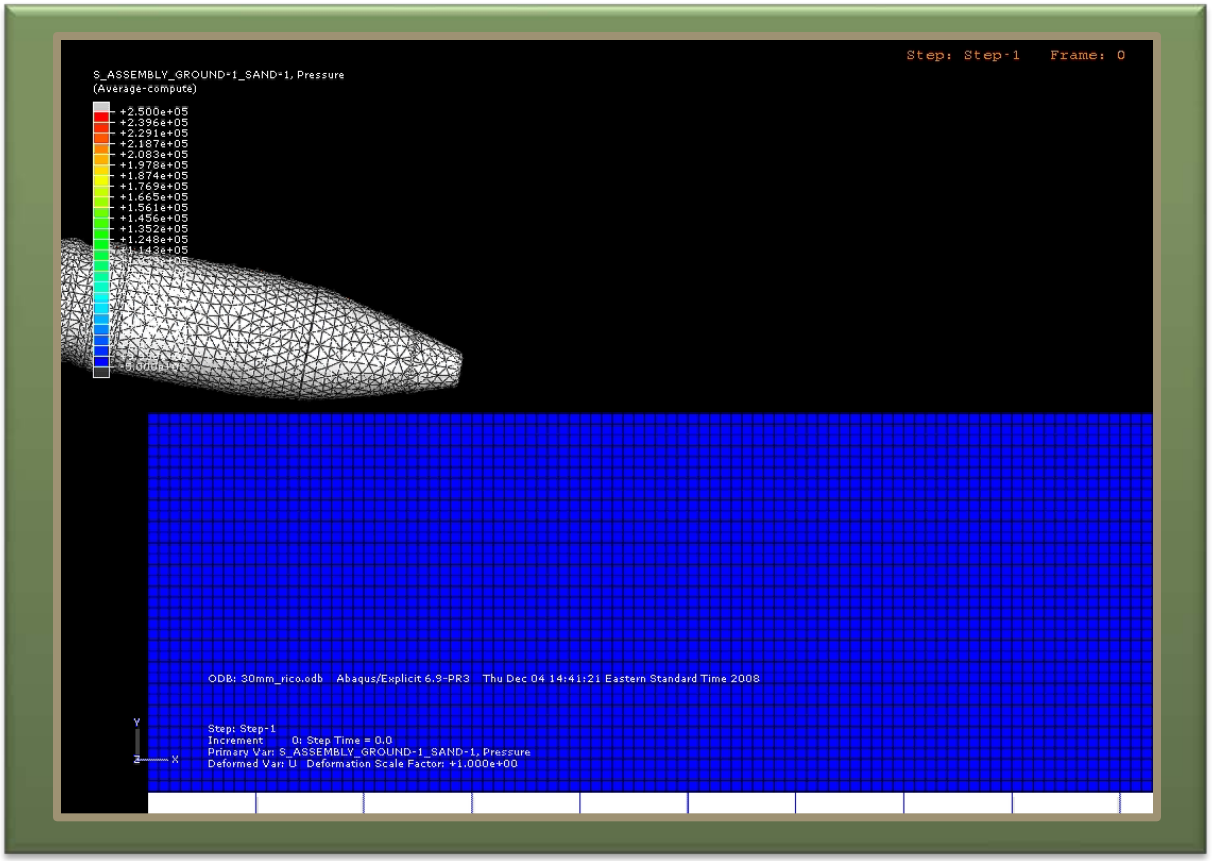
M789 Cartridge

- The M789 HEDP Cartridge is designed for use against light armor and anti-personnel targets
- The M789 is fired from the M230 Chain Gun on the Apache AH-64 helicopter



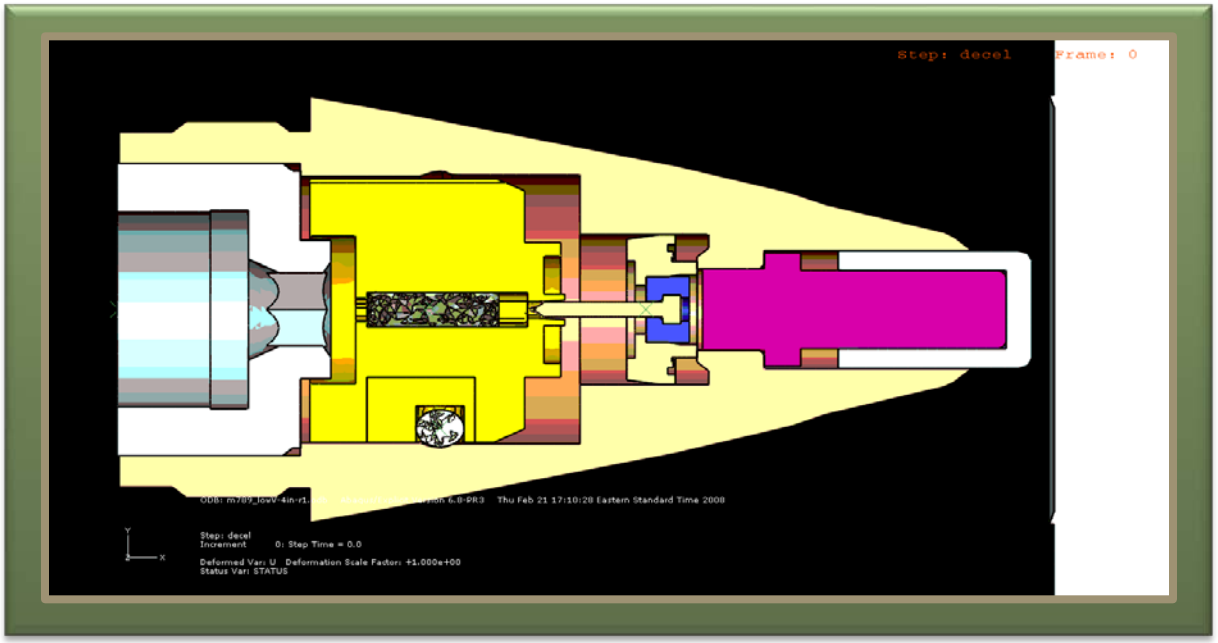
Problem

- When fired at soft targets such as sand or soil, at long range, the M789 will penetrate the target medium to a depth that minimizes the blast and fragmentation effect.
- A Fuze Technology Integration (FTI) Project was initiated to increase the soft target sensitivity of the M759 fuze



Insensitivity Investigation

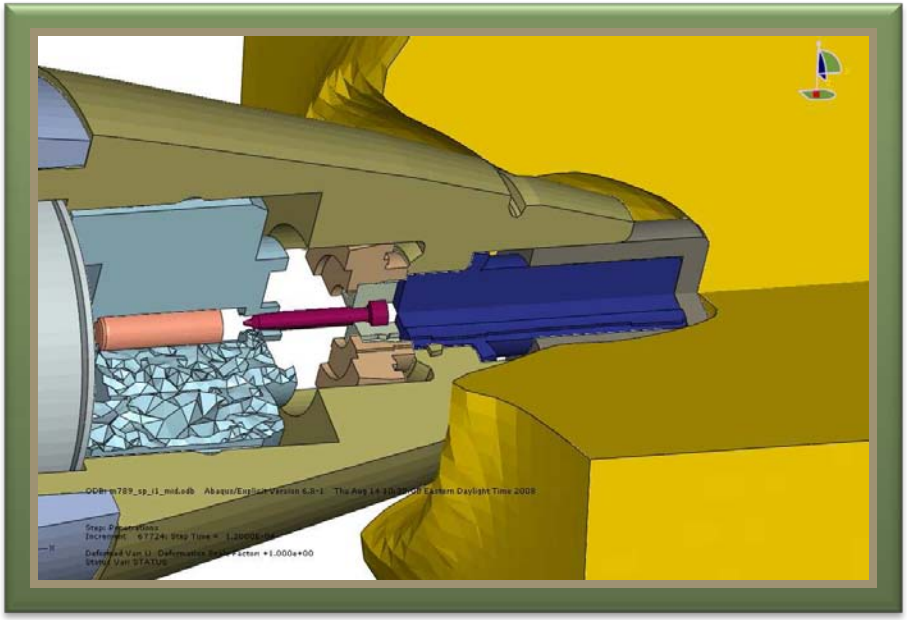
- User reports do not indicate any change in performance when the M789 cartridge is fired at hard targets
- No indication that cartridges were not detonating after impact with soft targets
- In an effort to understand the response of the current M759 configuration, modeling and simulation analysis was conducted

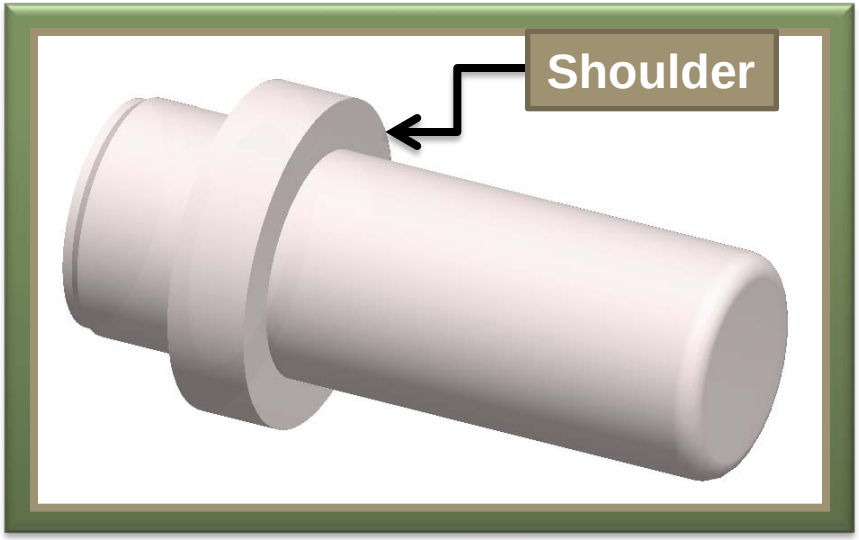


Results of M&S analysis show the projectile burying into soft target materials.

Probe Investigation

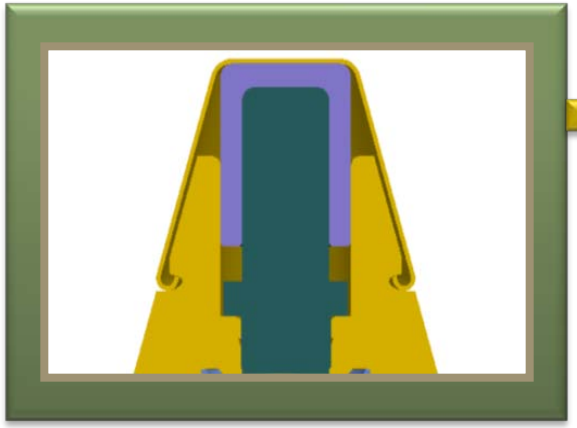
- On impact with a hard target, a shoulder feature on the glass-filled nylon probe shears, allowing it to impact the firing pin
- In addition to shearing the shoulder, the probe must overcome an interference fit in the o-give before it can slide into the firing pin
- Analysis shows that the shoulder does not shear on soft target impacts.



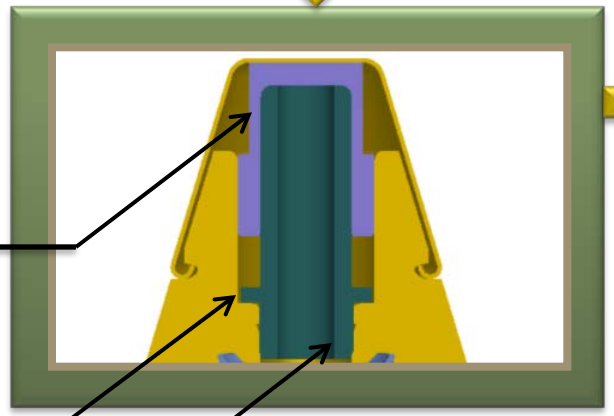


Probe Investigation

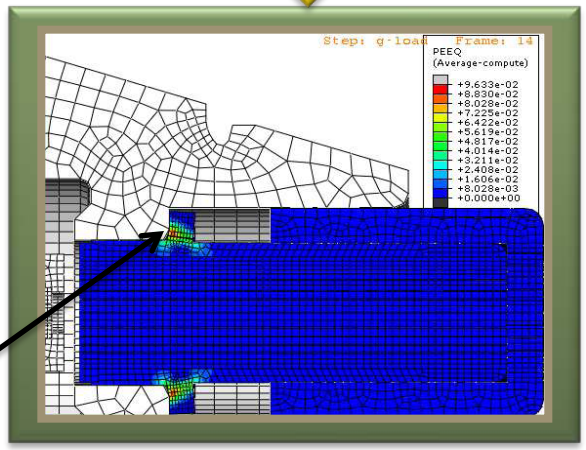
- **Efforts to optimize the probe, shoulder, and probe confinement cup did not yield a design that would survive the inertial loading during setback and shear on soft target impacts**



Confinement Cup Lightened



Shoulder Thinned, Probe Lightened

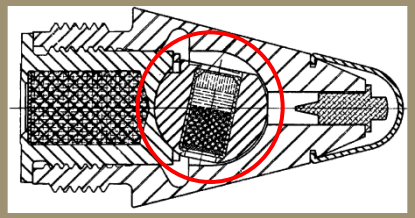


Probe Failure on Setback

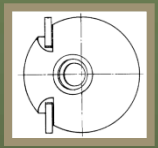
Spin Clip Design

- As an alternative to the probe shoulder feature, a spin clip solution was investigated
- The spin clip constrains the probe during setback and releases at the tactical spin environment
- A similar design approach is used in the M505A3 fuze
  - A spin clip provided anti-rotation to an unbalanced rotor

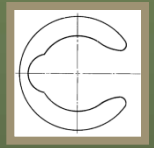
M505A3 Fuze Assembly



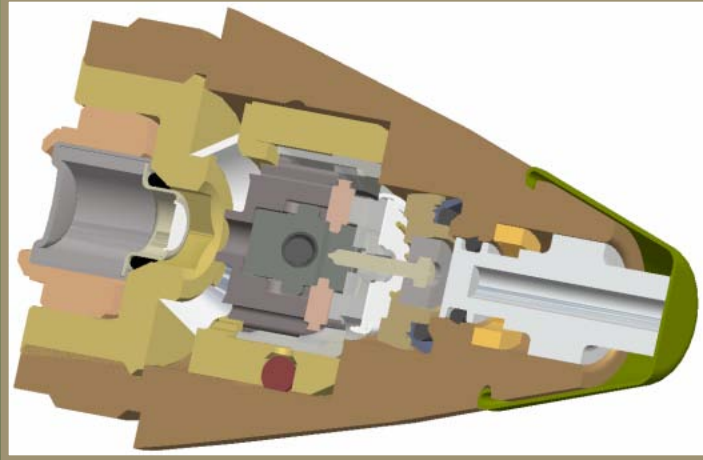
Rotor Assembly



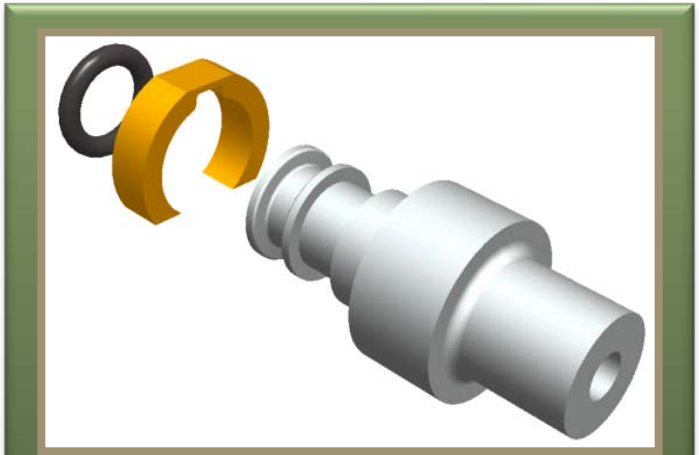
Rotor Detent Spring



M789 with Spin Clip



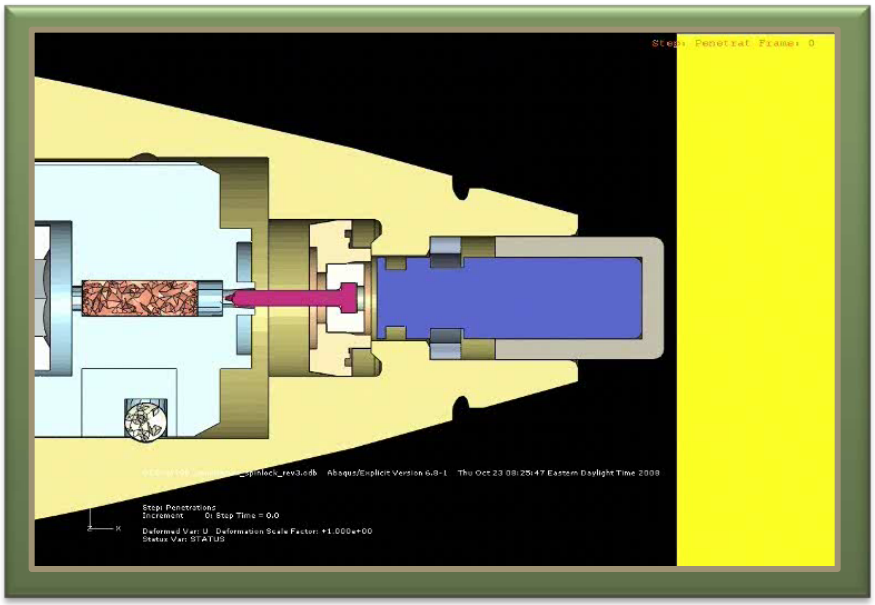
Modified Probe & Spin Clip



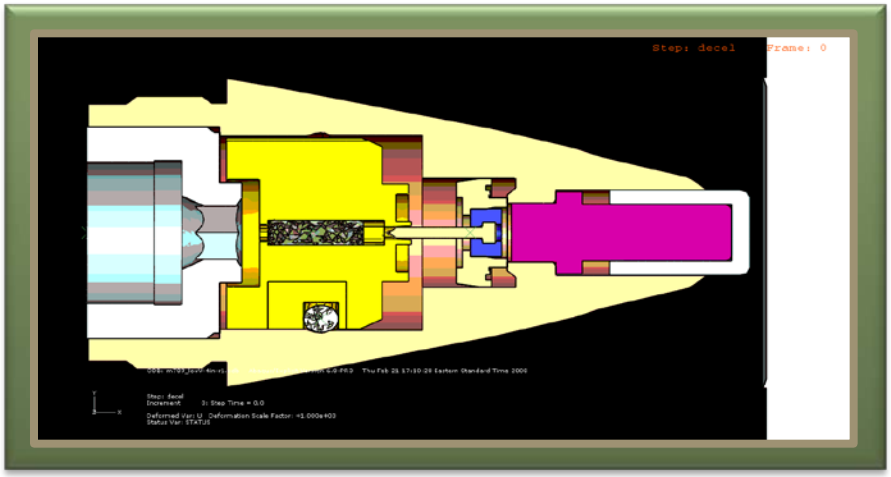
Spin Clip Design

- Baseline M759 model used to simulate spin clip performance
- Spin clip simulation illustrated increased sensitivity compared to baseline simulation on soft target impacts
- Long range (Low Speed) conditions were modeled in the simulation to illustrate the worst case sensitivity scenario

Spin Clip Configuration



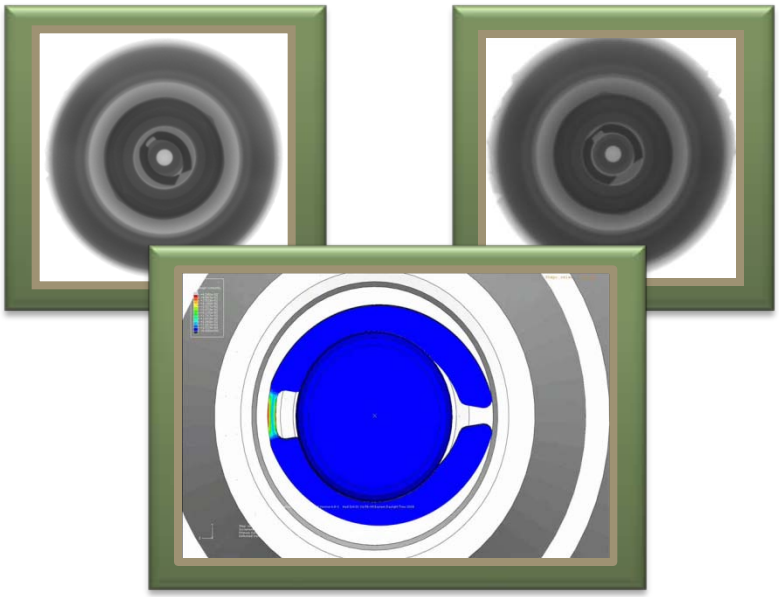
Production Configuration



Spin Clip Testing

- Small lot of spin clips and modified probes manufactured at the Fuze Development Center, ARDEC
- Airgun tests and high speed spin tests conducted to verify results of modeling and simulation
- Results of bench testing provided confidence to build prototype fuzes

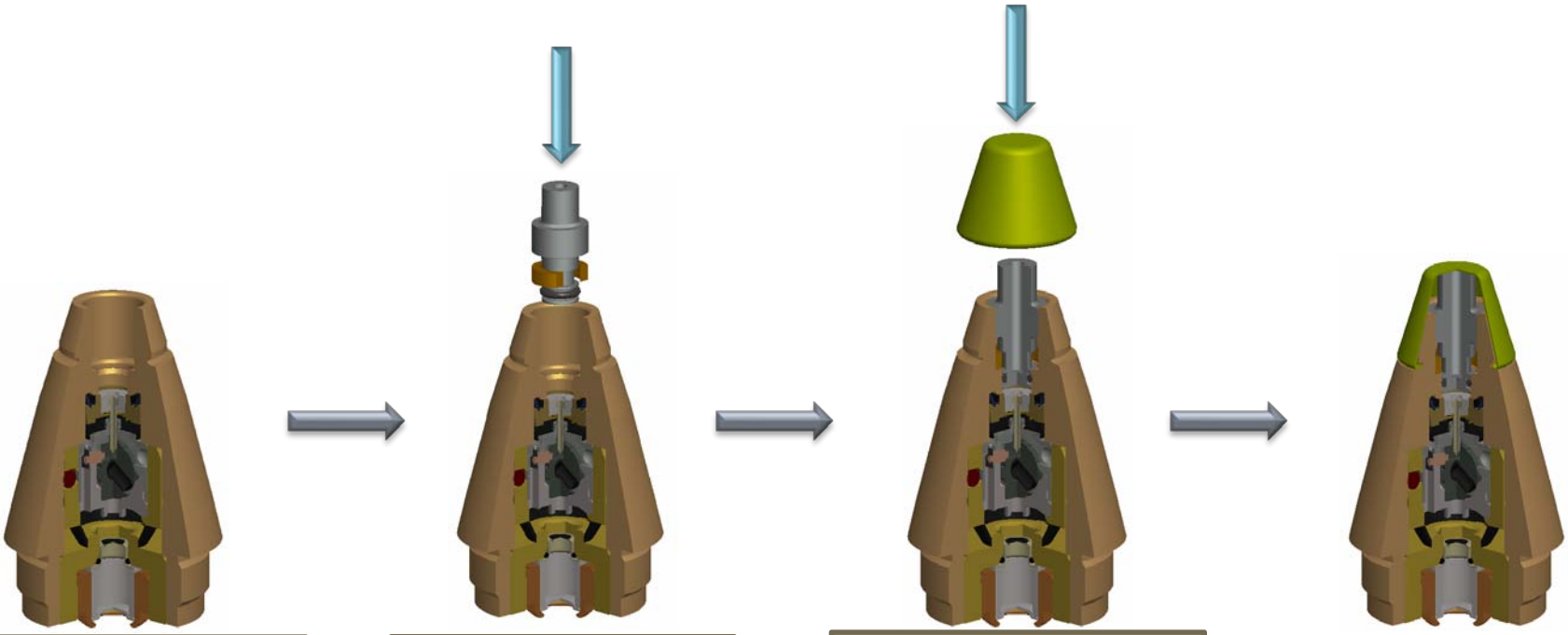
High Speed Spin Testing to 60,000 RPM



Airgun Testing To 125,000g's

Prototype M759

- April 2009, 110 prototype fuzes assembled at Allegheny Ballistics Laboratory (ABL), Rocket Center WV
- Fuzes were assembled on the assembly line, and removed at the probe installation step to be hand assembled



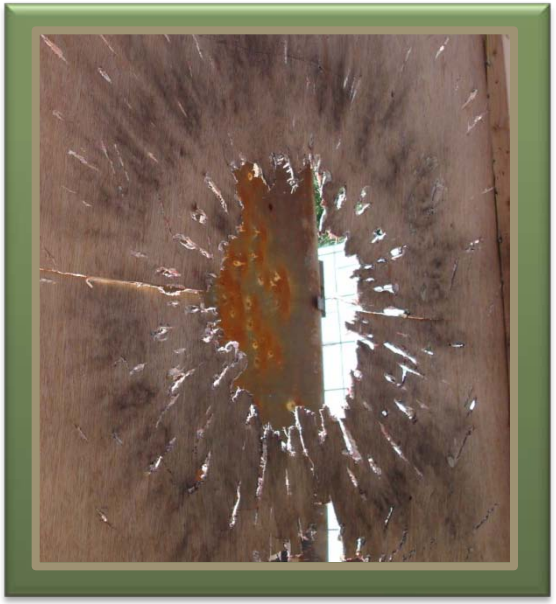
Fuzes removed from assembly line at probe installation.

Probe assemblies installed by hand.

Fuzes returned to assembly line for assembly completion.

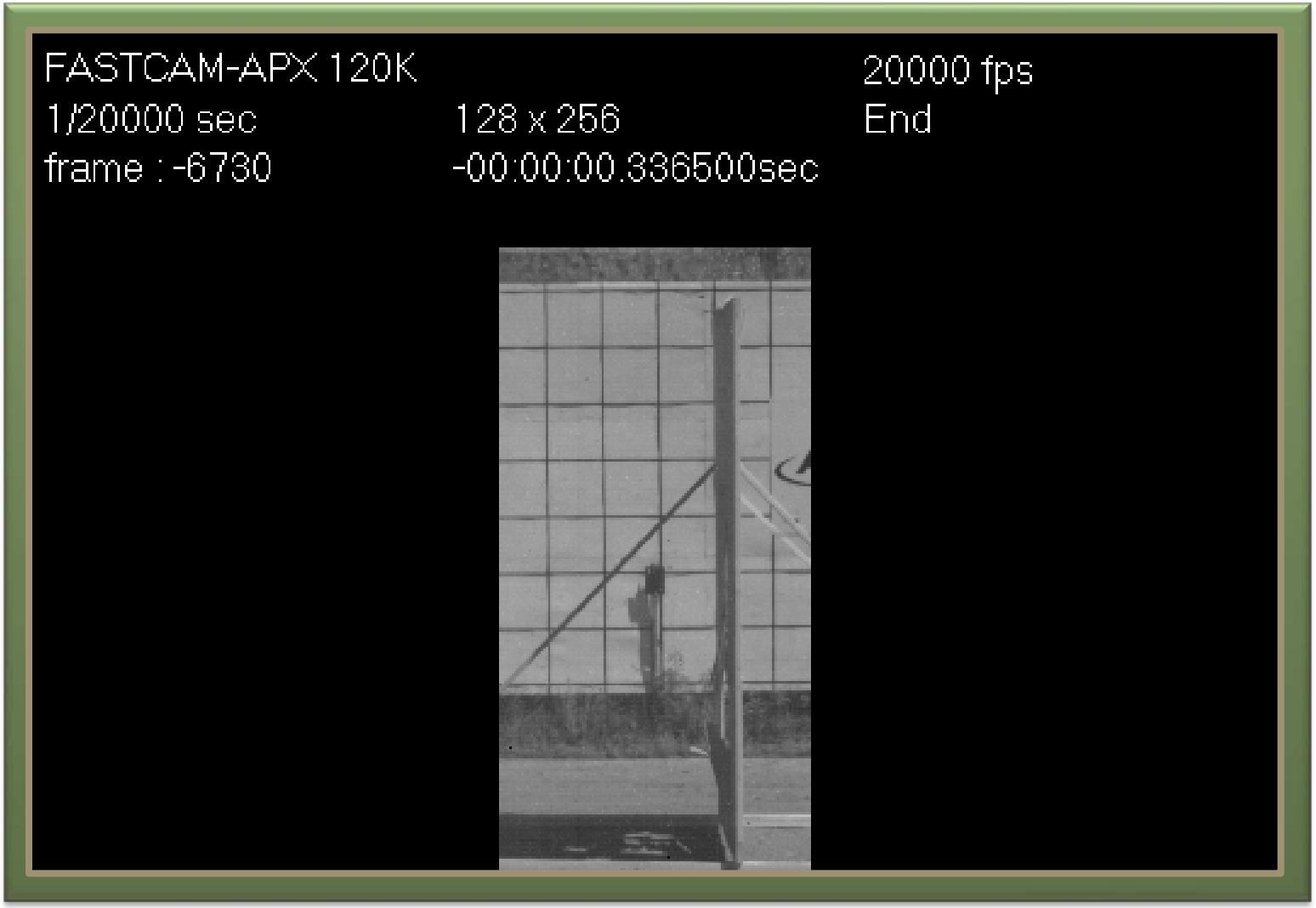
Prototype M789 Testing

- June 2009, soft target sensitivity testing was conducted at Alliant Technologies Proving Ground (ATPG), Elk River MN
- Prototype and production configuration M789 projectiles fired at ¼" plywood targets at a range of 1000m
- 45 prototype configuration projectiles detonated on impact with target, all prototype projectiles functioned on target
- 21 production configuration projectiles passed through plywood targets and detonated on impact with smash plate behind target, all production projectiles passed through target without functioning



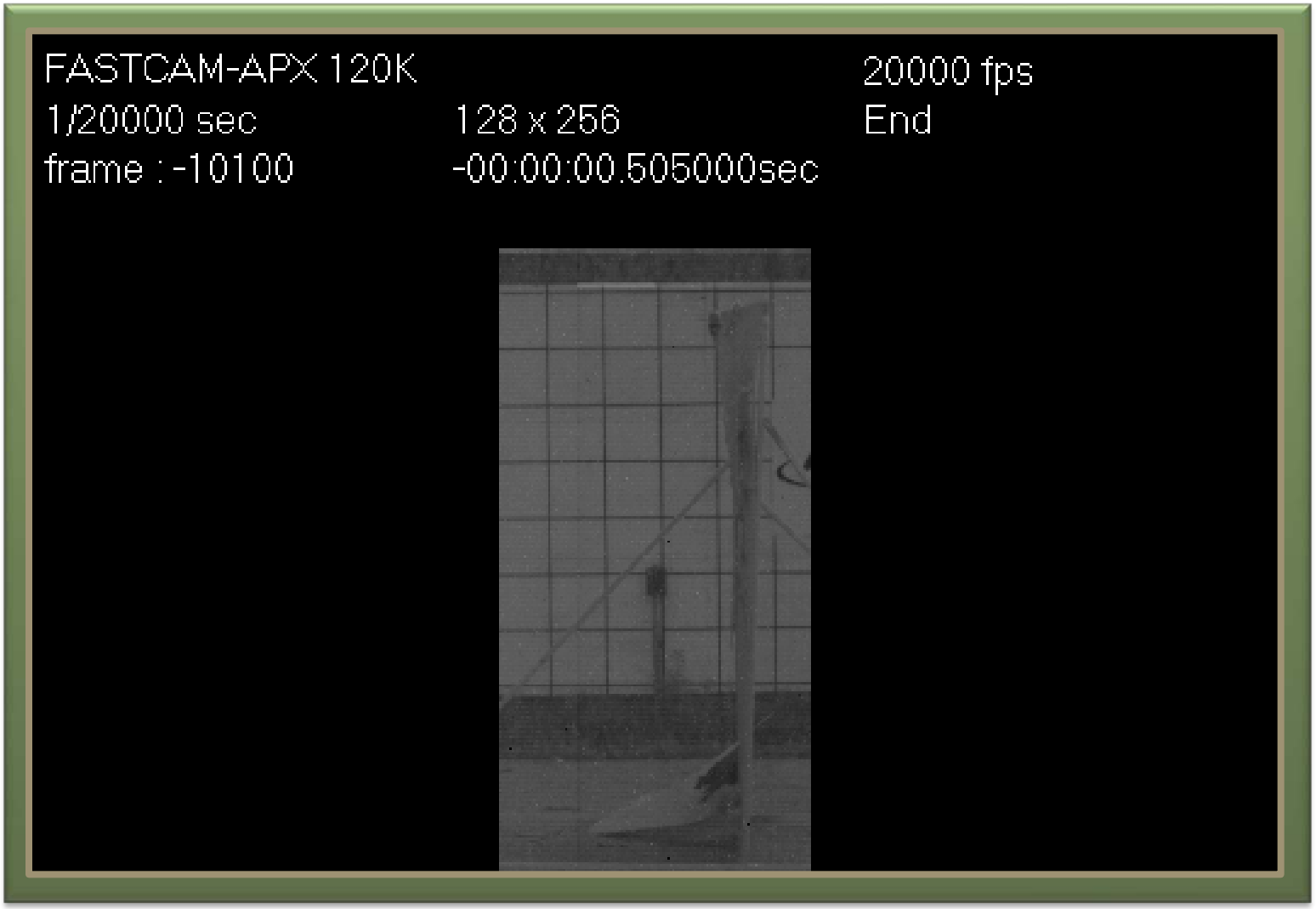
Prototype M789 Testing

Production Configuration M789, ¼” Plywood Target, 1000m



Prototype M789 Testing

Prototype Configuration M789, ¼” Plywood Target, 1000m



Prototype M789 Testing

- December 2009, sand target testing conducted at Yuma Proving Ground (YPG), Yuma AZ
- Prototype and production configuration M789 projectiles fired at a groomed sand pad at a 2000m range
- Complications with video coverage and projectile accuracy yielded few usable data points
- Delay can be seen in production configuration as projectile scrapes across the sand prior to detonating, no such delay seen in prototype configuration

Prototype M789 Testing

Production Configuration M789, Sand Pad, 2000m

Prototype M789 Testing

Prototype Configuration M789, Sand Pad, 2000m

Future Work

- Conduct assembly of additional 750 prototype cartridges
- Conduct Pre-First Article Acceptance Testing to verify performance
  - Arming, Non-Arming, TV-T, Target Reliability, Armor Plate Sensitivity
- Conduct Sand Berm Sensitivity Testing
  - Collect additional sand response data
- Conduct Brush Sensitivity Testing
  - ¼" Plywood, 1/16" Chipboard, ½" Celotex, ¼" Ø Wood Dowel Array
- Conduct fragmentation testing to quantify sensitivity affect on lethality

Questions?