Always a Step Ahead

ARDEC ARMAMENTS

FRAGMENT IMPACT TESTING OF THE XM25

APRIL 2018

IM&EM: REAL WARFIGHTER ADVANTAGE AND COST EFFECTIVE SOLUTIONS THROUGHOUT THE LIFECYCLE

PRESENTED BY NAUSHEEN AL-SHEHAB

UNPARALLELED COMMITMENT & SOLUTIONS

Act like someone's life depends on what we do.

U.S. ARMY RDECOM®

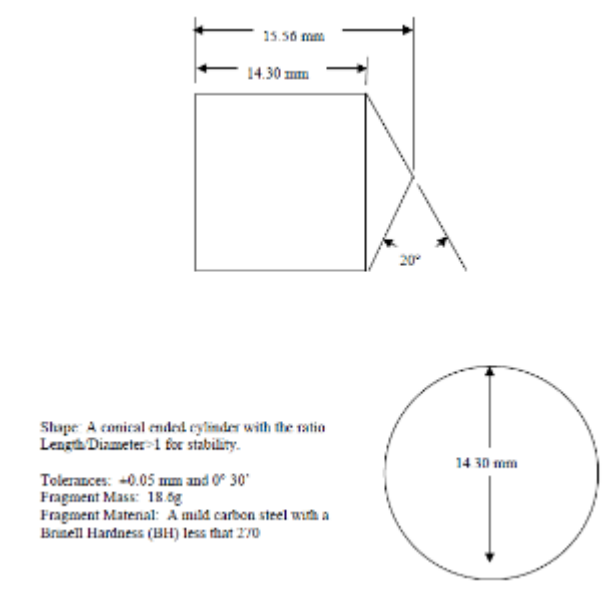
U.S. ARMY ARMAMENT RESEARCH, DEVELOPMENT & ENGINEERING CENTER

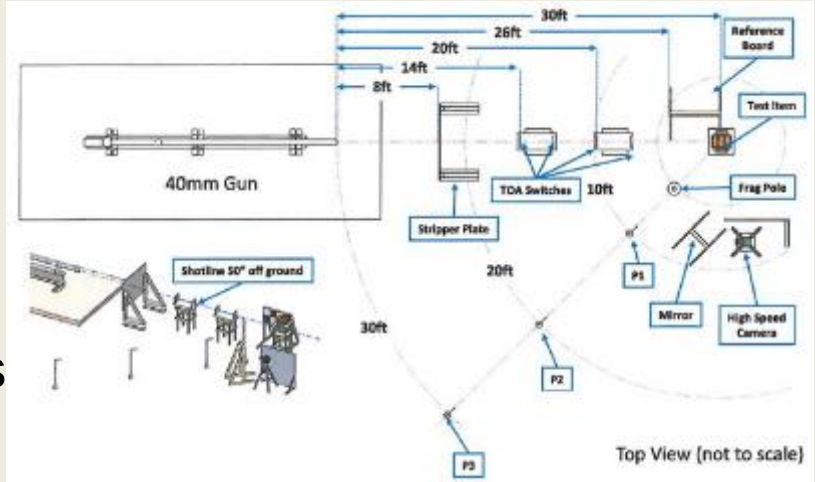
BACKGROUND

- The Counter Defilade Target Engagement (CDTE) is a shoulder-fired weapon system that gives Soldiers the ability to engage personnel targets behind cover
- The XM1083 High Explosive Air Burst (HEAB) projectile has dual steel warheads
- The XM1081 target practice (TP) fires an inert projectile with similar performance to the HEAB cartridge
- Both the TP and the HEAB rounds contain approximately 1.2 grams of commercial off the shelf shotgun propellant.

FRAGMENT IMPACT GUN TESTING

- U.S. IM fragment impact testing
  - MIL-STD-2105D
  - NATO STANAG 4496, Ed. 1
- Standard test: 2530±90 m/s
  - Alternate test of 1830±60 m/s
- Standard fragment (projectile) geometry
- Several loosely defined and undefined characteristics can affect the test item response
  - Velocity variation
  - Projectile tilt upon impact
  - Aim point variation
  - Fragment material characteristics





FI Test Configurations Tactical vs. Logistical

Tactical configuration consists of the cartridges packed inside of a PA108 container. Each container contains 2 trays of 40 cartridges

"Wirebound" logistical shipping consists of two PA108 containers inside of a wooden shell

1x PA108 Container

Top View

Orthogonal View

Pallet Straps

Tactical Configuration

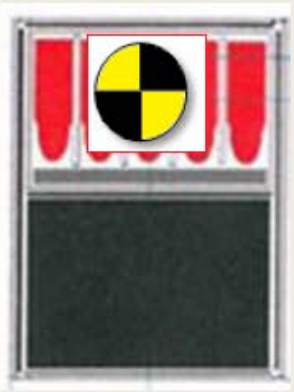
2x PA108 Container

Wire-bound Wood Crate

Logistical Configuration

FRAGMENT IMPACT AIM POINT AND SHOTLINES

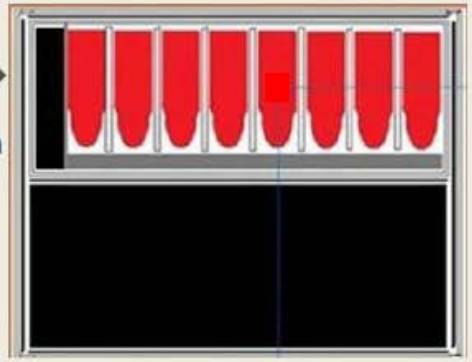
Frag Impact Aim Point



Frag Impact Hit Direction

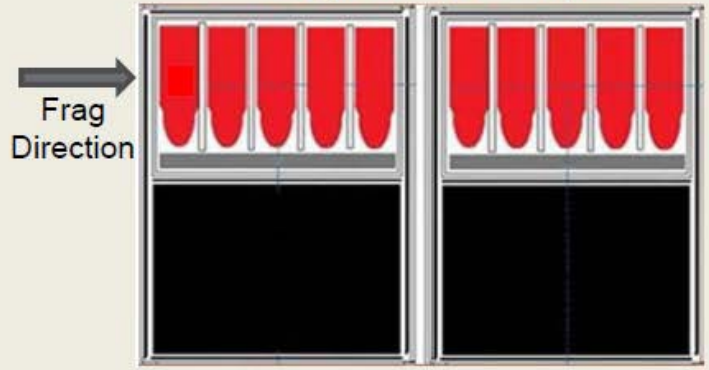
Tactical Test Setup

Frag Direction



Logistical Test Setup

Frag Direction

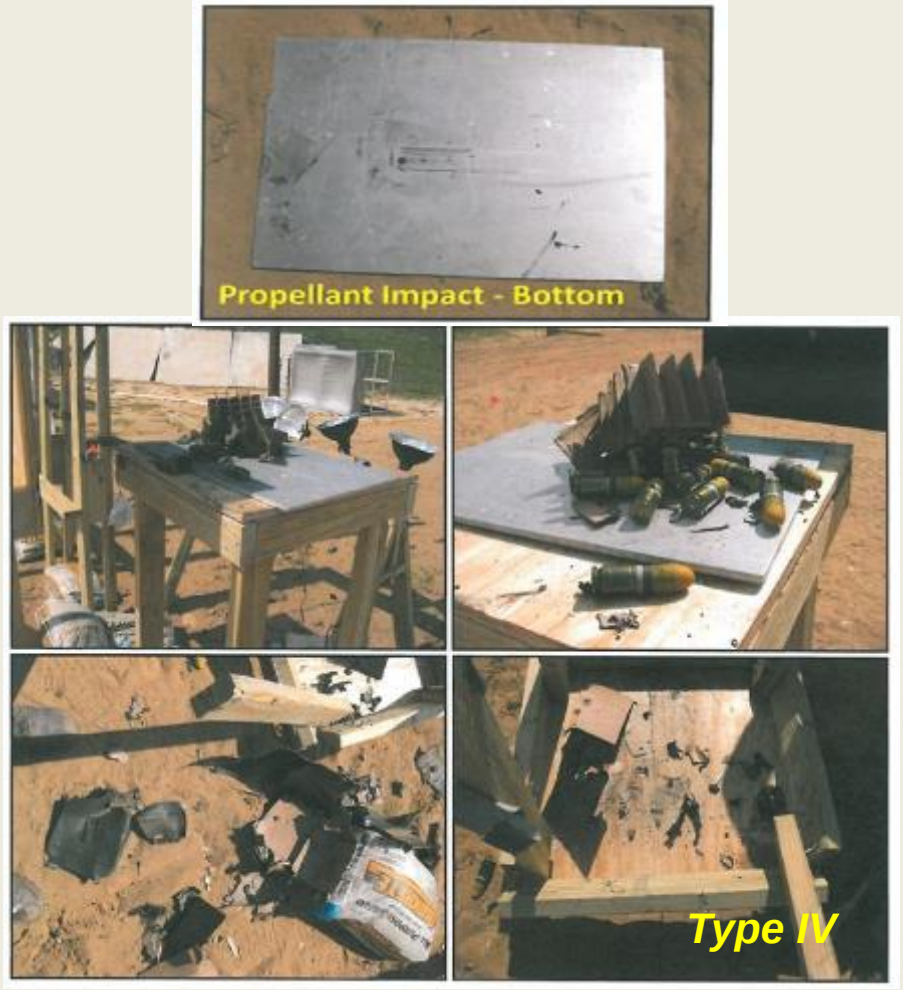


Test Setup

Test Setup

HEAB Engineering FI Tests

Propellant Shotline (Tactical Configuration)



2448m/s

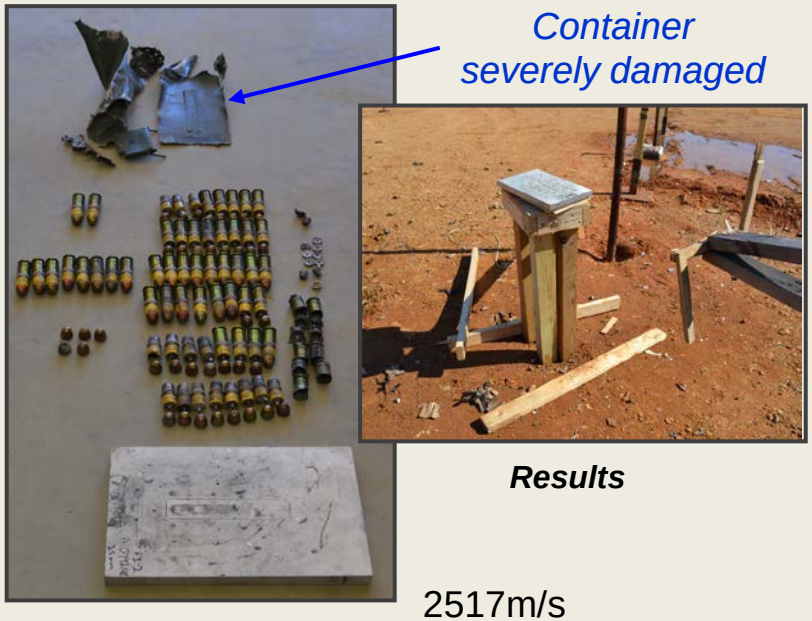
Explosive Shotline (Tactical Configuration)

2527m/s

HEAB Formal FI Tests

Propellant Shotline (Tactical Configuration)

Test Setup



Results

2517m/s

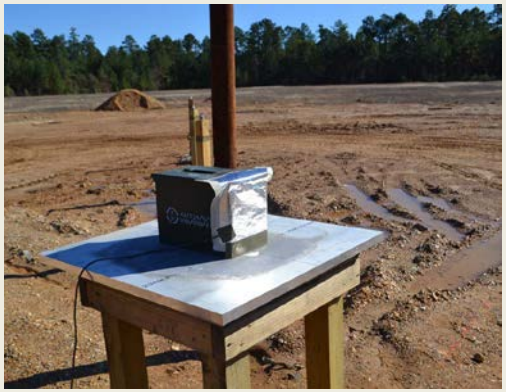
Explosive Shotline (Logistical Configuration)

Test Setup

2461m/s

TP Formal FI Tests

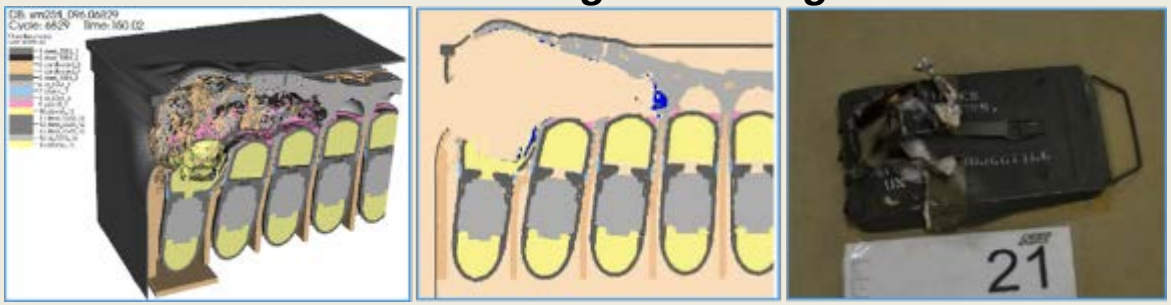
Tactical Configuration



Logistical Configuration

High Speed Video Footage

Inert cartridge Modeling



Holes in lid likely caused by debris

Lid likely thrown due to hydraulic effect

TP Formal FI Tests

Tactical Configuration


Shot 1
(2004m/s)

Shot 2
(2486m/s)

Shot 5
(2500m/s)

Logistical Configuration

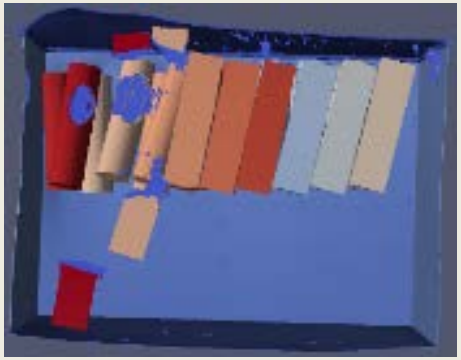

Shot 3
(2525m/s)


Shot 4
(2495m/s)

All lids are bowed and thrown > 30 meters

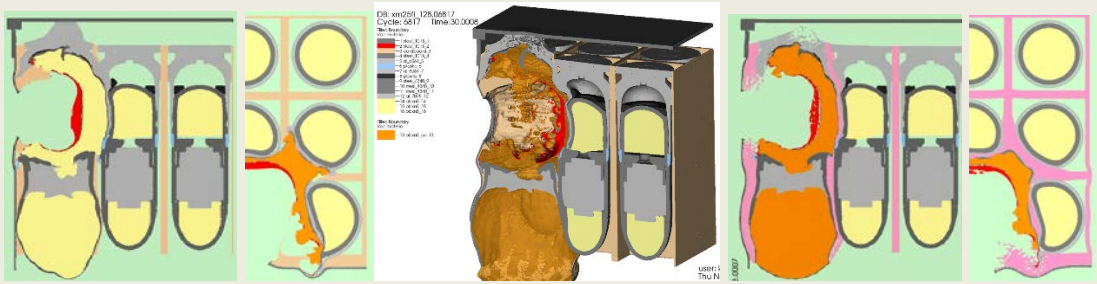
All lids are perforated, except for the lower velocity tactical configuration

FI Modeling and Testing Inert Simulants



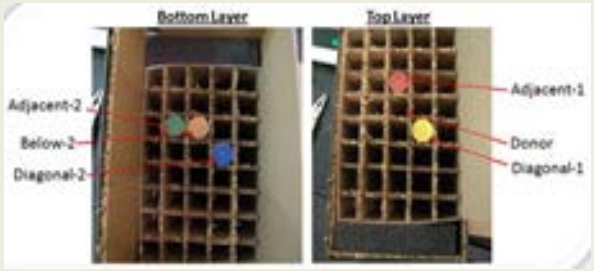

- *EPIC modeling of inert simulants suggests damage to lid may be from cartridge fragmentation.*
- *Inert simulant testing results also show no holes in lids, suggesting that, in the TP configuration tests, holes may be caused by debris field from the cartridge case fragments*
- *Lids were thrown from the test stand, although not as far as in the TP tests*

FI/SYMPATHETIC REACTION (SR) SPACING DESIGNS AND HYDROCODE MODELING



- *Significant directionality to shock generated in adjacent cartridges*
- *Reduced peak pressure induced in adjacent cartridges*

SR Test Results - HEAB



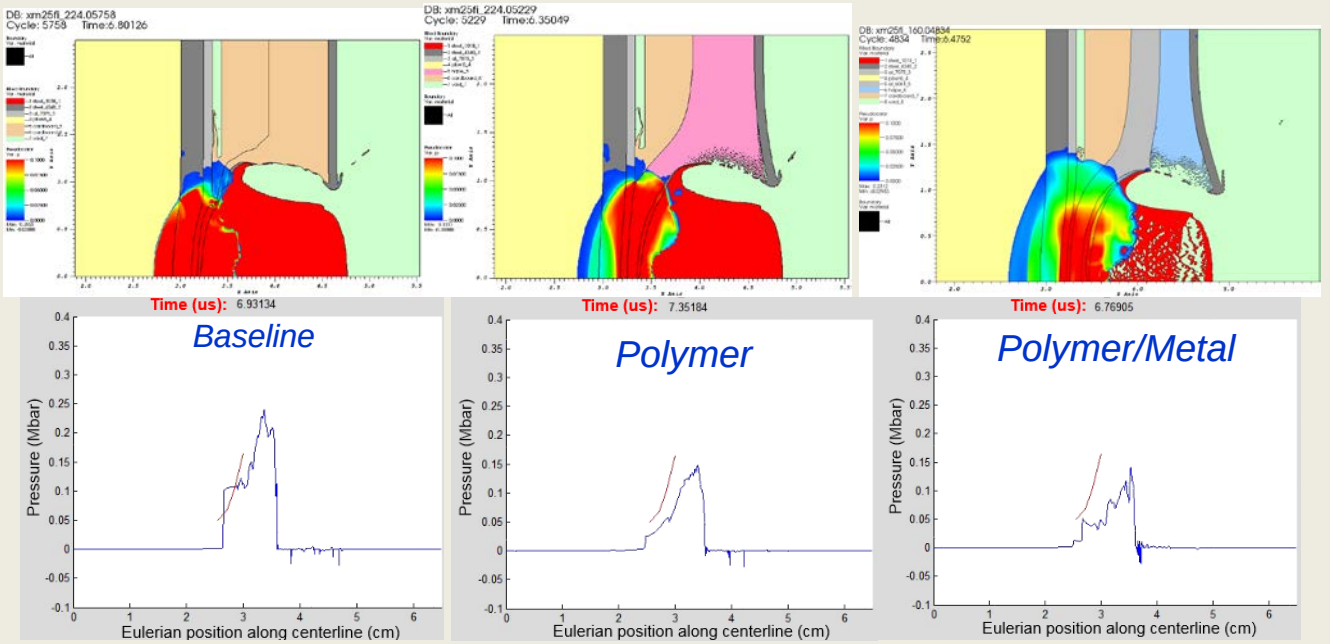
FI Barrier Designs Hydrocode Modeling

Pop plot data

Pressure (kbar)	Run to Detonation (mm)
48	4.6
68	2.9
101	1.7
164	--

Configuration	Wedge Test Criterion	Gap Test Criterion
Baseline CF	Fail	Fail
Wood	Marginal	Fail
Polymer	Marginal/Pass	Fail
Polymer/Metal1	Pass	Fail
Porous Al	Pass	Fail
Solid Al	Fail	Fail
Polymer/Metal2	Marginal/Pass	Fail
Metal2	Fail	Fail

Several candidate barrier configurations



Designs explored to mitigate initial impact shock

Summary

- Both engineering level tactical configuration and formal logistical configuration FI tests show that impacting the explosive results in an explosion.
- Tactical configuration tests, engineering and formal, of the packaged cartridge impacting the propellant had mixed results.
  - Potential aimpoint variation due to challenges with FI testing
- TP cartridges and inert simulants caused the lid to be thrown
  - Lids were thrown farthest and were perforated in tests with TP cartridges
  - Modeling suggests that lid perforation is likely caused by cartridge debris throw and the lid is thrown due to hydraulic effects
- SR testing causes cartridges in the same row to explode, however, this is not transmitted to the row below. Based on modeling results of the PIMS, there are several potential candidates for replacement dunnage that may reduce reaction violence.

Acknowledgements

- **PdM IW** – Andre Cline
- **APO** - Bob Phung
- **ARDEC 25mm System Engineer** - Robert Greenfield
- **JIMTP** – Anthony DiStasio and Stanley DeFisher
- **US Army Test Facility** – Ed Mooney
- **National Testing Service** – Matt Brian
- **Orbital ATK** – Vince Martinez
- **GD-OTS** – David Hunter
- **ARDEC** – Tim Madsen

Questions

Thank You!