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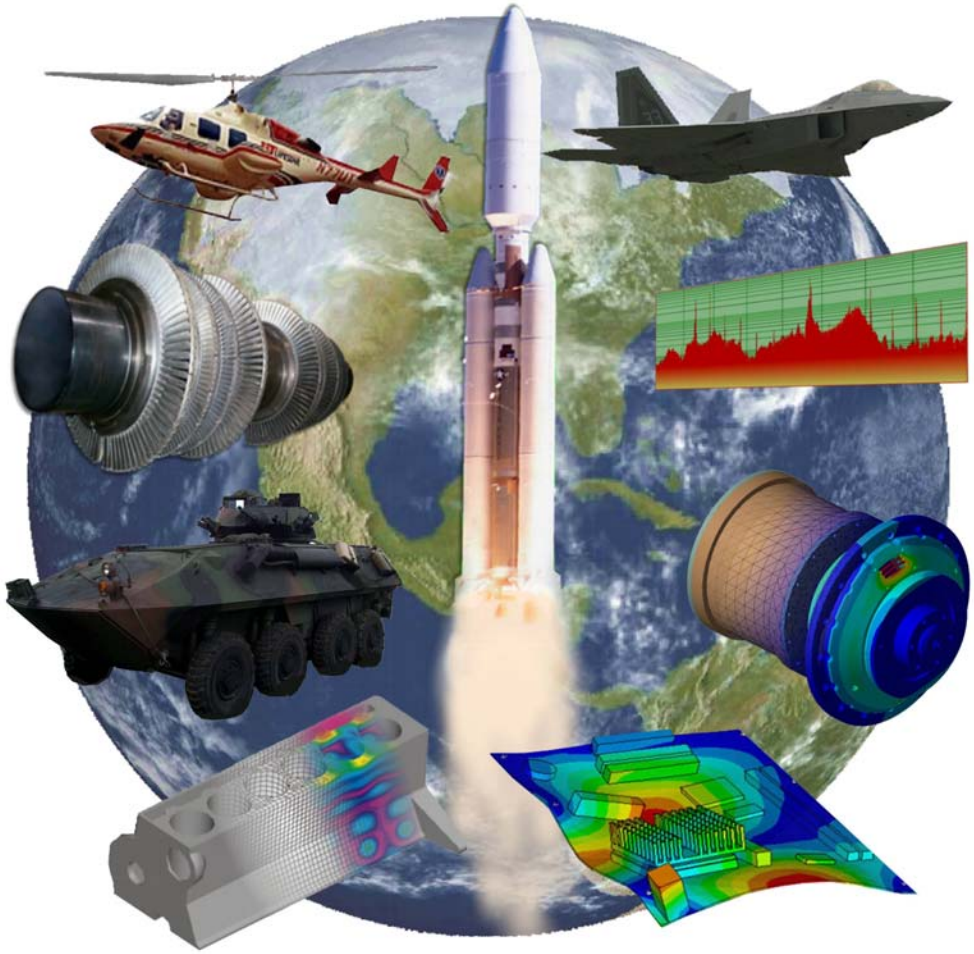
Engineering Analysis, Test & Technology

40 mm Less Lethal Munitions



Prepared for:

NDIA Joint Services Small Arms Systems Annual Symposium, Exhibition, & Firing Demonstration

Virginia Beach, VA

***Prepared by*:**

Keith Olasin

Paul Boyadjis

7-10 May 2007

11 Apollo Drive, Whippany, New Jersey 07981-1423
Tel: (973) 326-9920 Fax: (973) 326-9919
Email: ejo@mechsol.com Website: www.mechsol.com

MSI Company Background

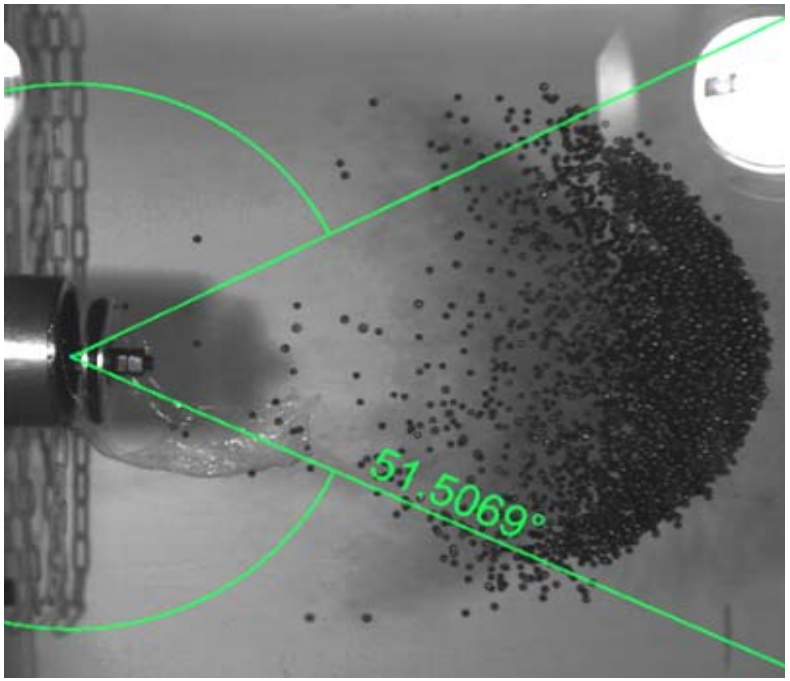
Mechanical Solutions, Inc.
Engineering Analysis, Test & Technology

1996 – Company Founded as NJ S-Corp

2000 – Filtration Solutions, Inc. (Wharton, NJ)
Spun Off as an SBIR Commercialization

2002 – US Dept. of Commerce Best
Technology Small Business in NJ

2007 – MSI record of SBIR commercializations
>80% of Phase I's awarded Phase II



Launch-tube testing at MSI of RPG-Defeat ShotScreen™ munition

Core Competency:

Less-Lethal Munitions Design & Development

40 mm Non-Lethal SafeShot™ Round

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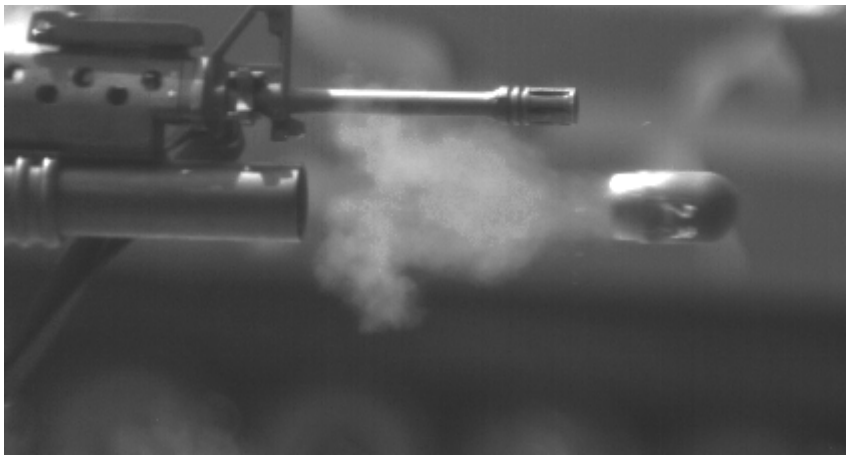
Paul Boyadjis, PI



- ***Fires from standard M203 launcher***
- ***Demonstrated effective up to 100 meters***
- ***Replacement for M1006 sponge grenade***
- ***Marker-round option***

40 mm Non-Lethal Round Goals

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- ***Extend range of the 40 mm non-lethal to 100 m***
- ***Exceed current M1006 Sponge grenade accuracy at 50 m. of 65% hit rate***
- ***Determine a standard hit rate at 75 m where none currently exists for the M1006 (Minimum of 65% at 75 m)***
- ***Impart greater impact energy at 50 and 75 m than is currently delivered by the M1006***

MSI's 40 mm SafeShot™ Projectile

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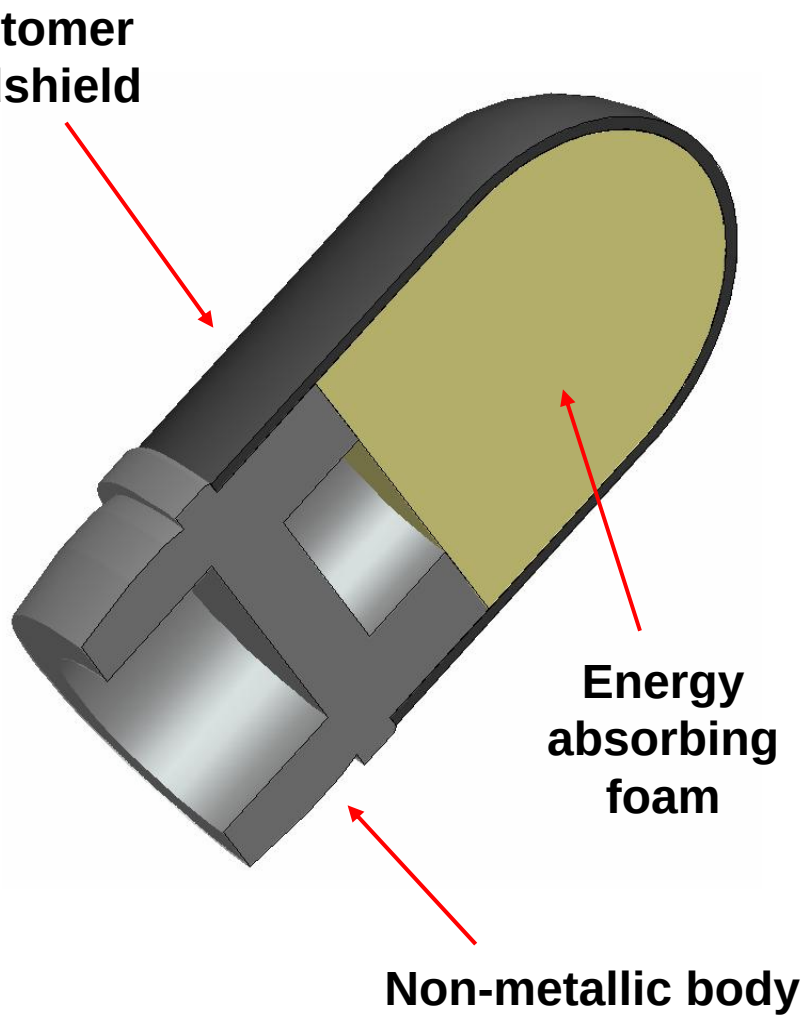
Weight = 51.5 grams

Powder charge = 170 mg Bullseye with standard hi/low adapter

Average muzzle velocity = 235 fps

Calculated muzzle energy = 97 ft*lbs

Average ballistic clay depth = 1.685" (2.7% below limit of 1.732" at 10m)



MSI's Projectile Analysis & Test

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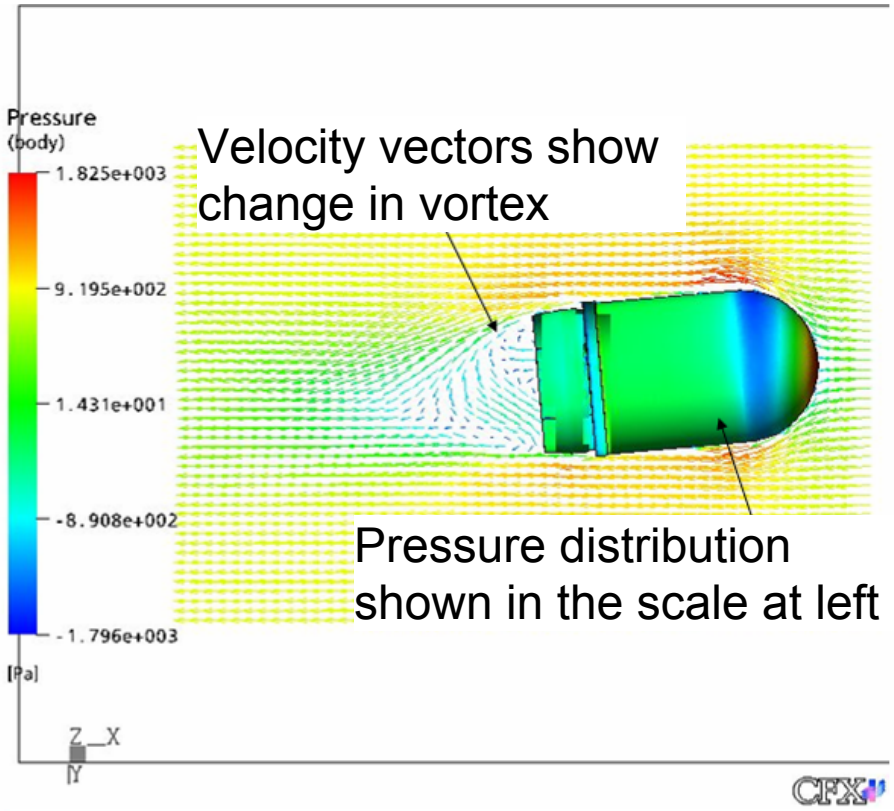
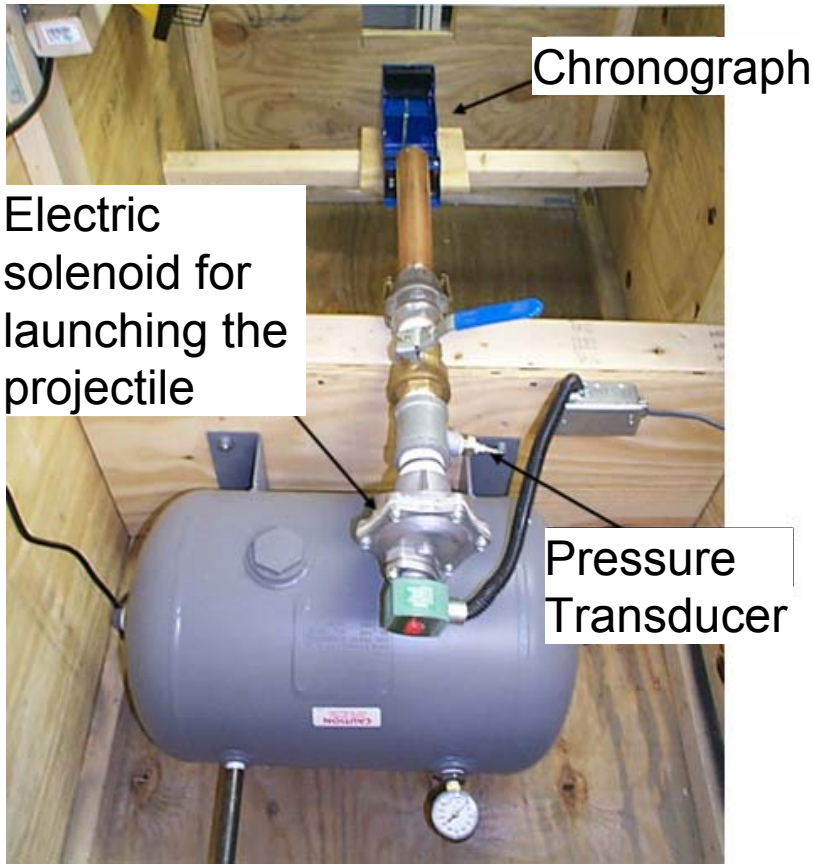


Pressure distribution at 5 degrees of yaw



MSI's pneumatic launcher system

Impact Depth of Various Materials

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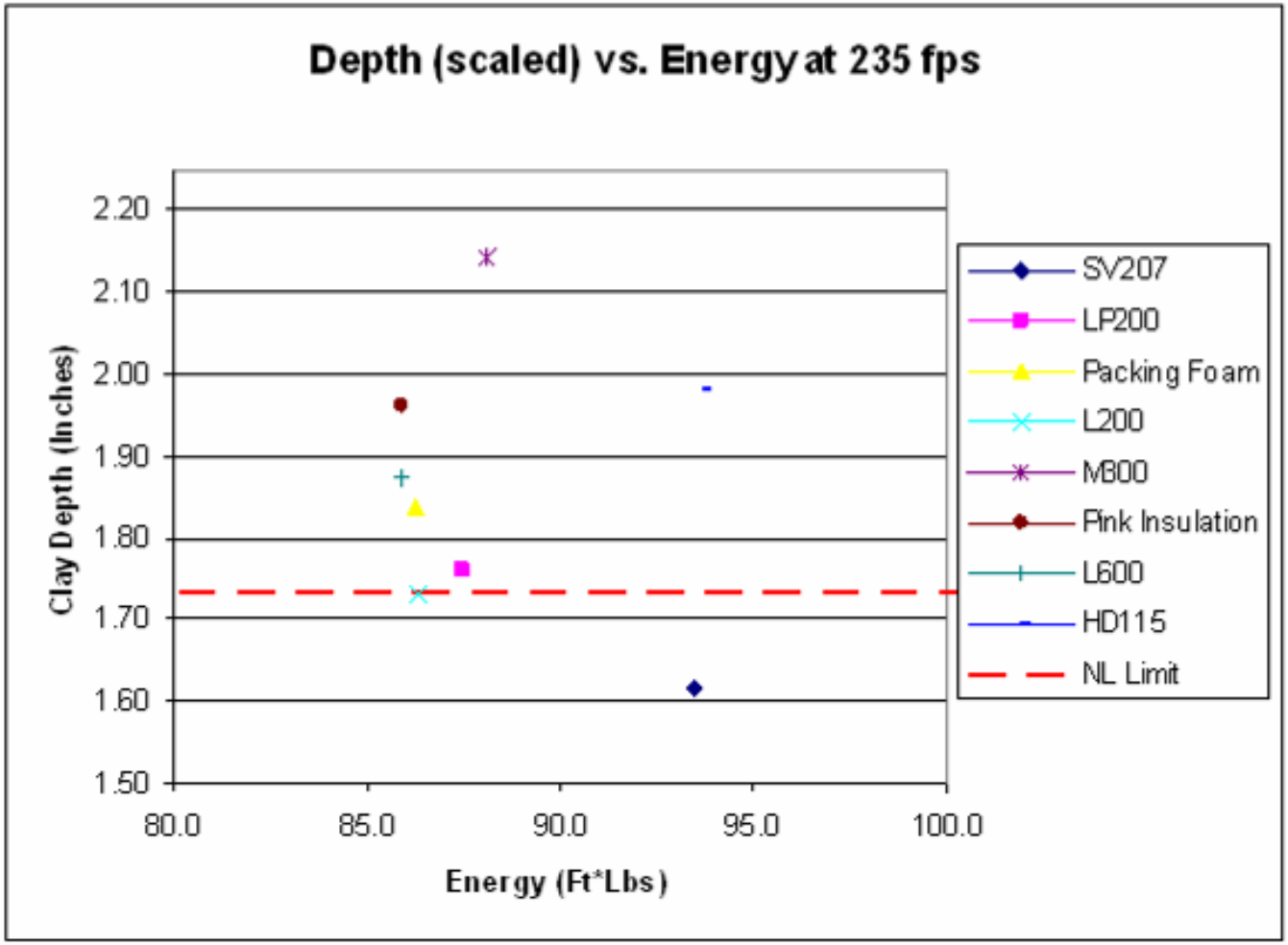

Performance comparison of various foams for ballistic clay testing

40 mm Less-Lethal Round

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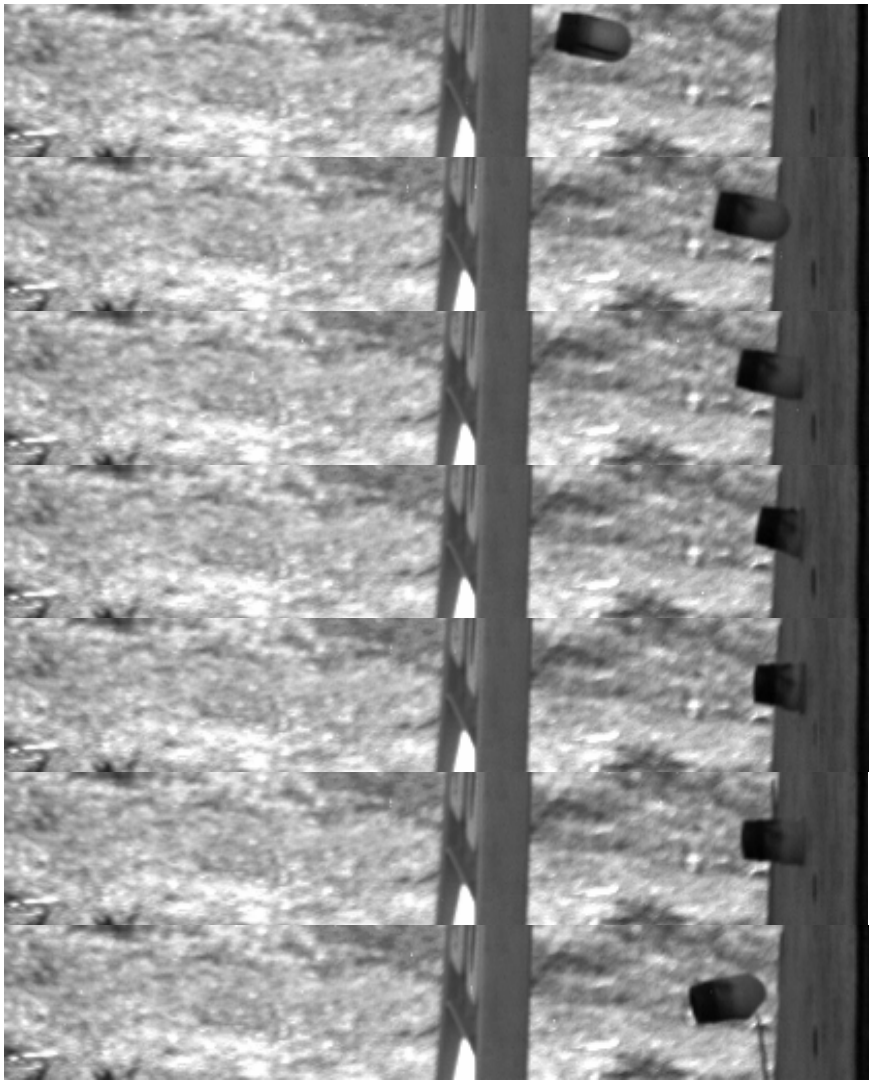

Impact images taken with MSI's High Speed Camera

Projectile impacting ¾" plywood located 75 meters down range at 200 fps

50 Meter Dispersion Test

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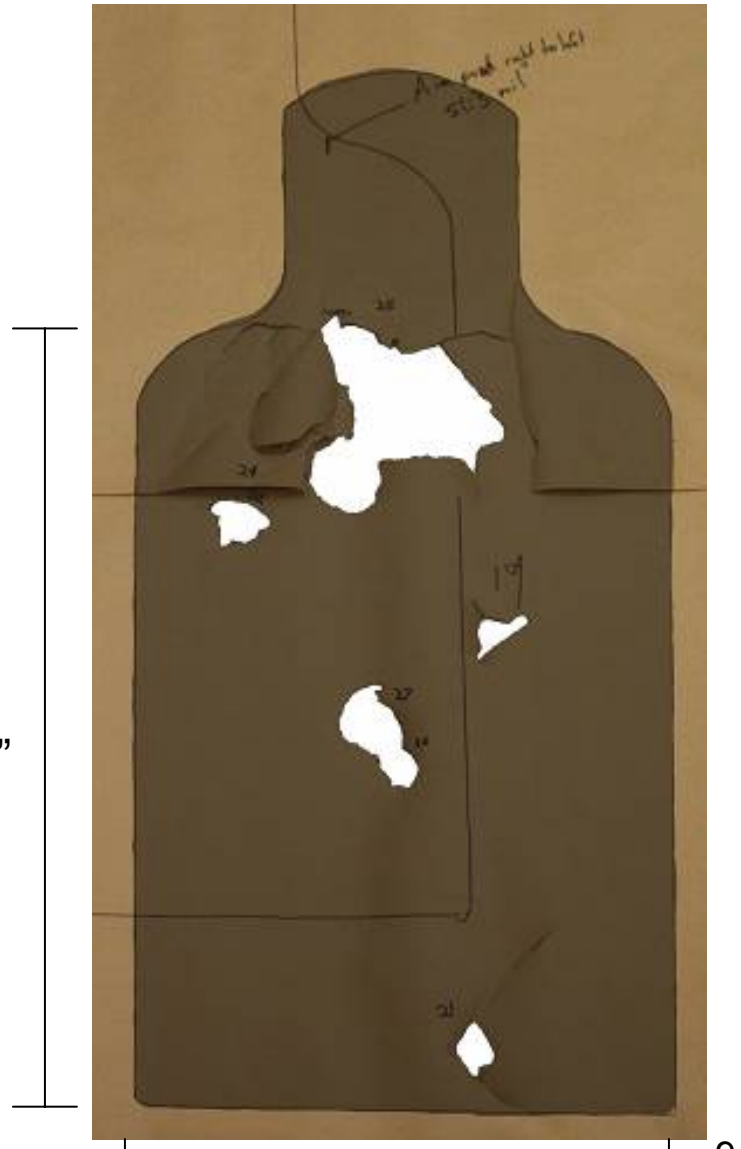
10 rounds from a solid mount:

- ***QE of 51 mils***
- ***100% of impacts were within an E-silhouette outline***
  - Approx. 12” horizontal spread and 30” vertical spread
- ***Muzzle velocity standard deviation = 8.00 ft/s***

Impact Velocity at 50 meters	
Avg. Vel. (fps)	**Energy (ft*lbs)**
210.56	78.2

*M1006 at 10 meters has 67 ft*lbs of energy



75 Meter Dispersion Test

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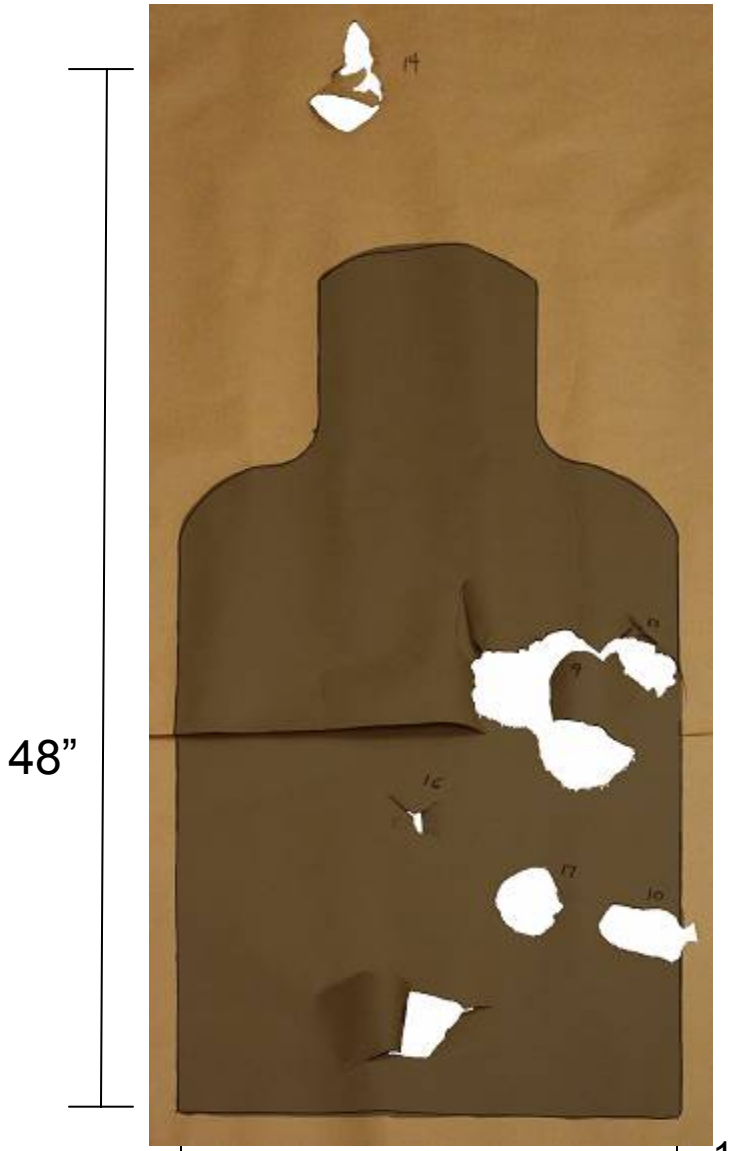
10 rounds from a solid mount:

- ***QE of 80 mils***
- ***90% of impacts were within an E-silhouette outline***
  - Approx. 12” horizontal spread and 48” vertical spread
- ***Muzzle velocity standard deviation = 6.15 ft/s***

Impact Velocity at 75 meters	
Avg. Vel. (fps)	**Energy (ft*lbs)**
180.33	57.4

*M1006 at 10 meters has 67 ft*lbs of energy



Ballistic Clay Testing

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Clay was tested to meet NIJ specifications prior to firing

- ***Target set-up at 10 meters***
- ***Predicted values based on MSI lab testing were 1.575" with muzzle velocity 240 fps (within 6.5% of actual results)***

Averages based on 5 shots	Muzzle Vel. (fps)	Depth (inch)	Diameter (inch)	Muzzle Energy (ft*lbs)	% Away from Limit (1.732" NL Limit)
	238.8	1.685	2.28	100.8	-2.74%

Impact Energy vs. Range

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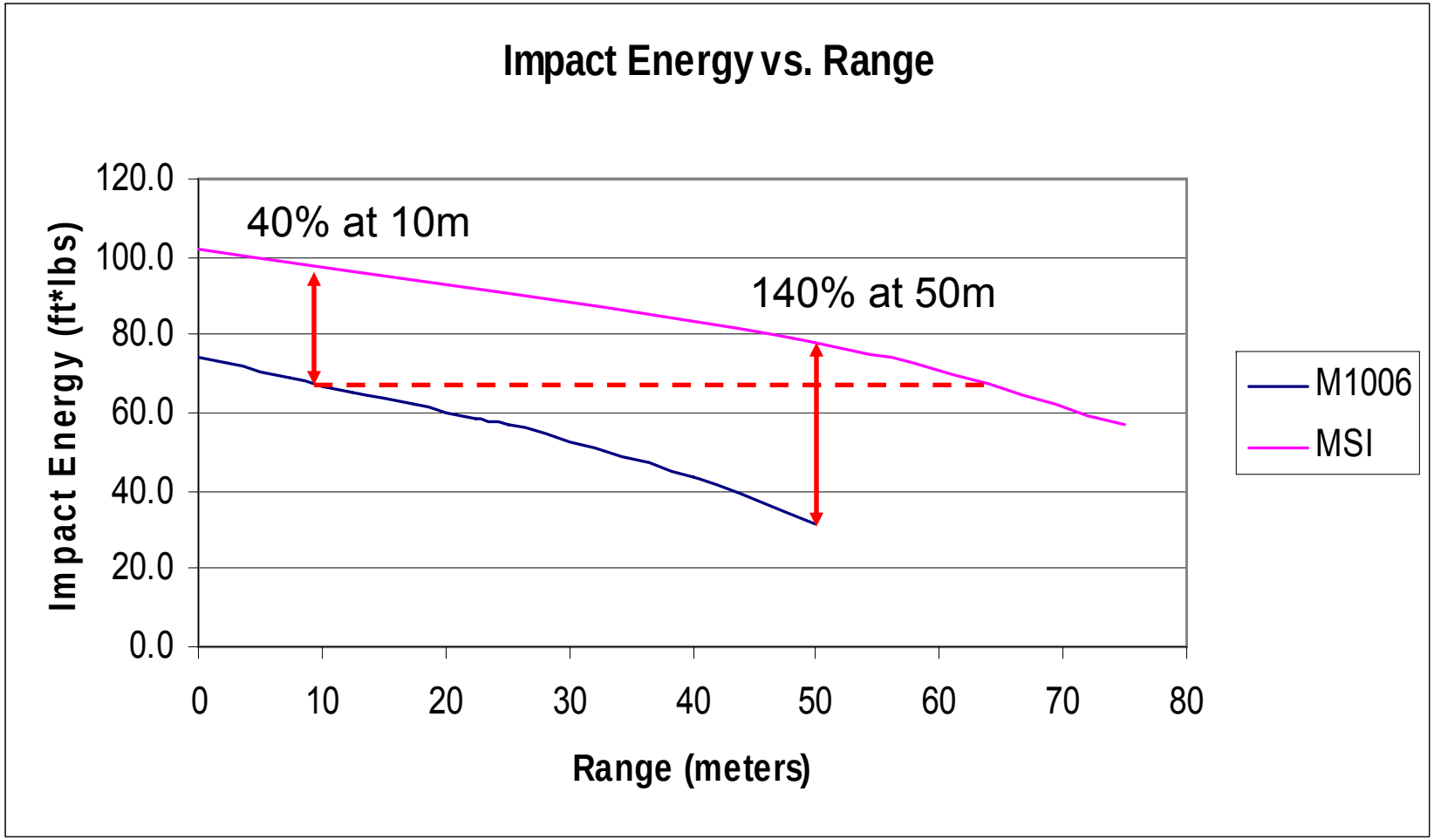

MSI's projectile has higher initial impact energy and maintains velocity downrange

MSI's 40 mm Non-lethal Summary

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Hit probability on E-silhouette exceeded goals:

- ***100% at 50 meters***
- ***90% at 75 meters***

Ballistic clay test showed non-lethality even with more energy:

- ***Delivers over 40% more impact energy at 10 meters than current M1006 while remaining non-lethal***
- ***Maintains velocity downrange better than current M1006 – approximately 140% more impact energy at 50 meters***

Projectile reliability during 38 test shots:

- ***Velocity standard deviation of 12.1 fps (8.1 with no outliers)***
- ***None of the projectiles exhibited instability (barrel does not need to be cleaned)***
- ***Minimal horizontal dispersion even at 75 meters***

INNOVATIVE WALL PENETRATION MUNITION

Keith Olasin, PI

Innovative Wall Penetration Munition

Mechanical Solutions, Inc.
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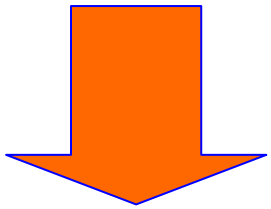
<u>CHALLENGE</u>: ACCESS EMPLACED ENEMY IN URBAN ENVIRONMENT

Problems with structure window & door access:

Conventional = anticipated

Booby-trapped / shielded

Defended by well-armed enemies



Perforate structure walls quickly = Key MOUT* tool

* - Military Operations on Urban Terrain

"Wall Penetrator" Desirable Features -

- Reduce soldier's exposure
- Mobility
- Minimize collateral damage
- Cost-effective approach
  - Build on already-familiar platform
  - Avoid type-classification of new weapon
- Consider wall-perforation parameters
  - Mobility (soldiers) vs. attack (materials)

Proposed Solution: Medium-caliber munition

- 40 mm Caliber = Compatible with M203 launcher
- Options: Less-Lethal or Lethal

Operational Capabilities -

- ***Compatible*** with M203 40mm grenade launchers
  Proven by insertion of full-scale model into weapon
- ***Perforate*** typical concrete structure wall
- ***Deliver*** payload through **concrete wall** to interior space
- ***Adaptable*** - variety of lethal or less-than-lethal future payloads / applications
- Firing accuracy - achieved through spin-stabilization and aeroballistic analysis
- Weight of cartridge approximately 1-lb_m

Innovative Wall Penetration Munition

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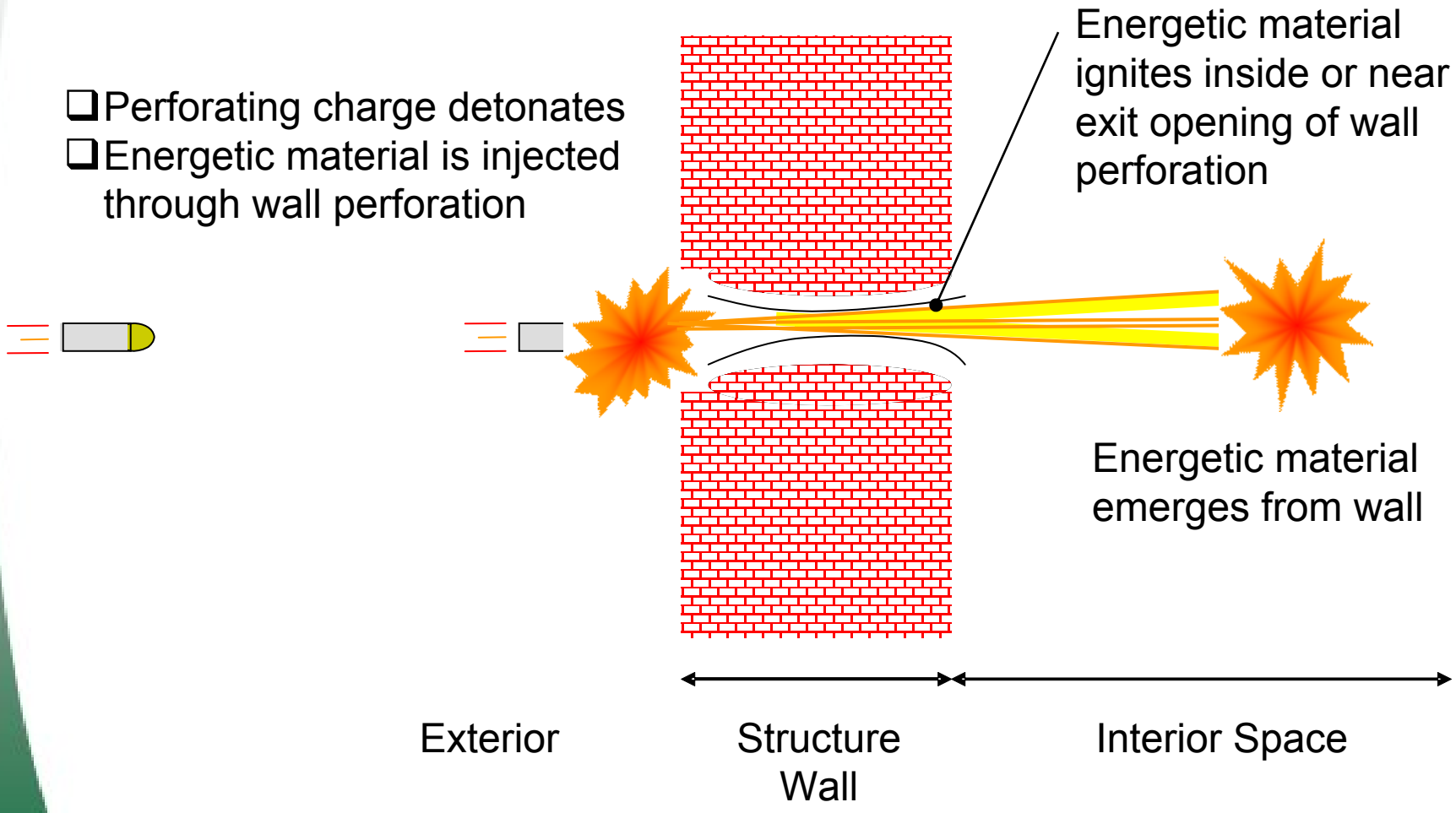
CONCEPT 1 – *OPERATION OF THE INNOVATIVE WALL PENETRATION MUNITION*

- Perforating charge detonates
- Energetic material is injected through wall perforation



Innovative Wall Penetration Munition

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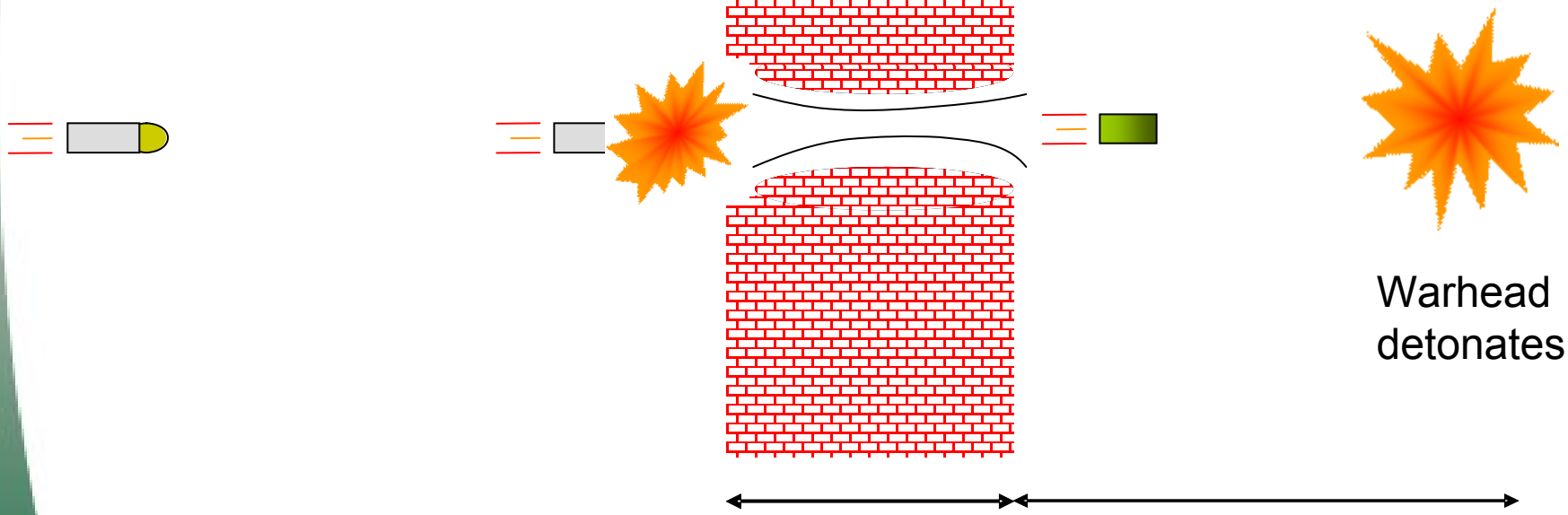
CONCEPT 2 - OPERATION OF THE INNOVATIVE WALL PENETRATION MUNITION

- ❑ Perforating charge detonates
- ❑ Warhead enters perforation in structure wall

Warhead emerges from target wall



Innovative Wall Penetration Munition

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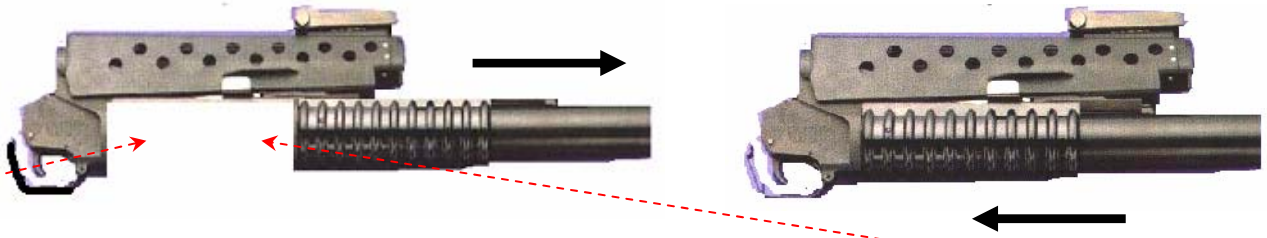
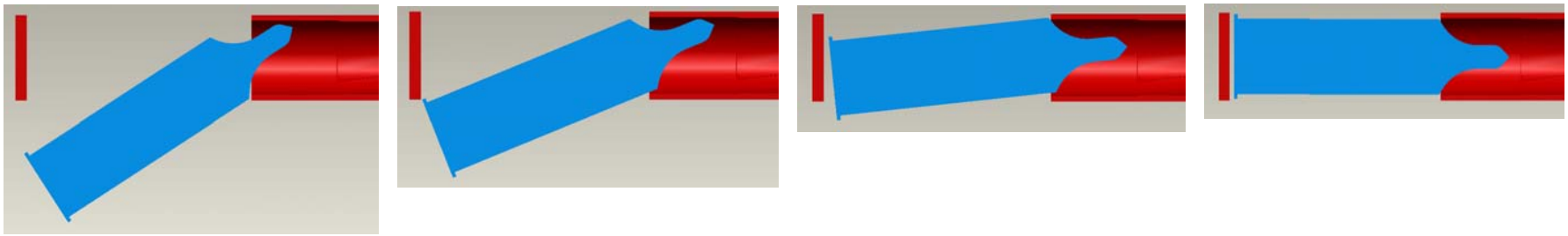
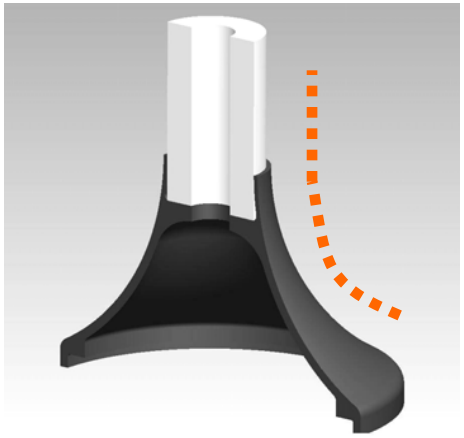
MSI's 40 mm INNOVATIVE WALL PENETRATION MUNITION HAS BEEN DESIGNED TO BE FIRED FROM ANY STANDARD M203 LAUNCHER:

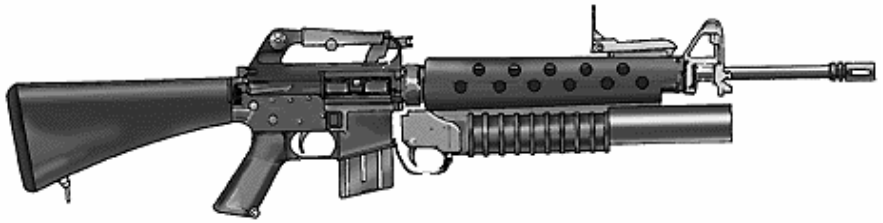
TO LOAD THE M203, A BREECH LOADING WEAPON, THE BARREL SLIDES FORWARD TO OPEN THE FIRING CHAMBER







MSI'S UNIQUELY CONTOURED **WINDSHIELD DESIGN** IS THE KEY TO THE 40 mm ROUND'S COMPATIBILITY WITH THE M203 LAUNCHER



Innovative Wall Penetration Munition

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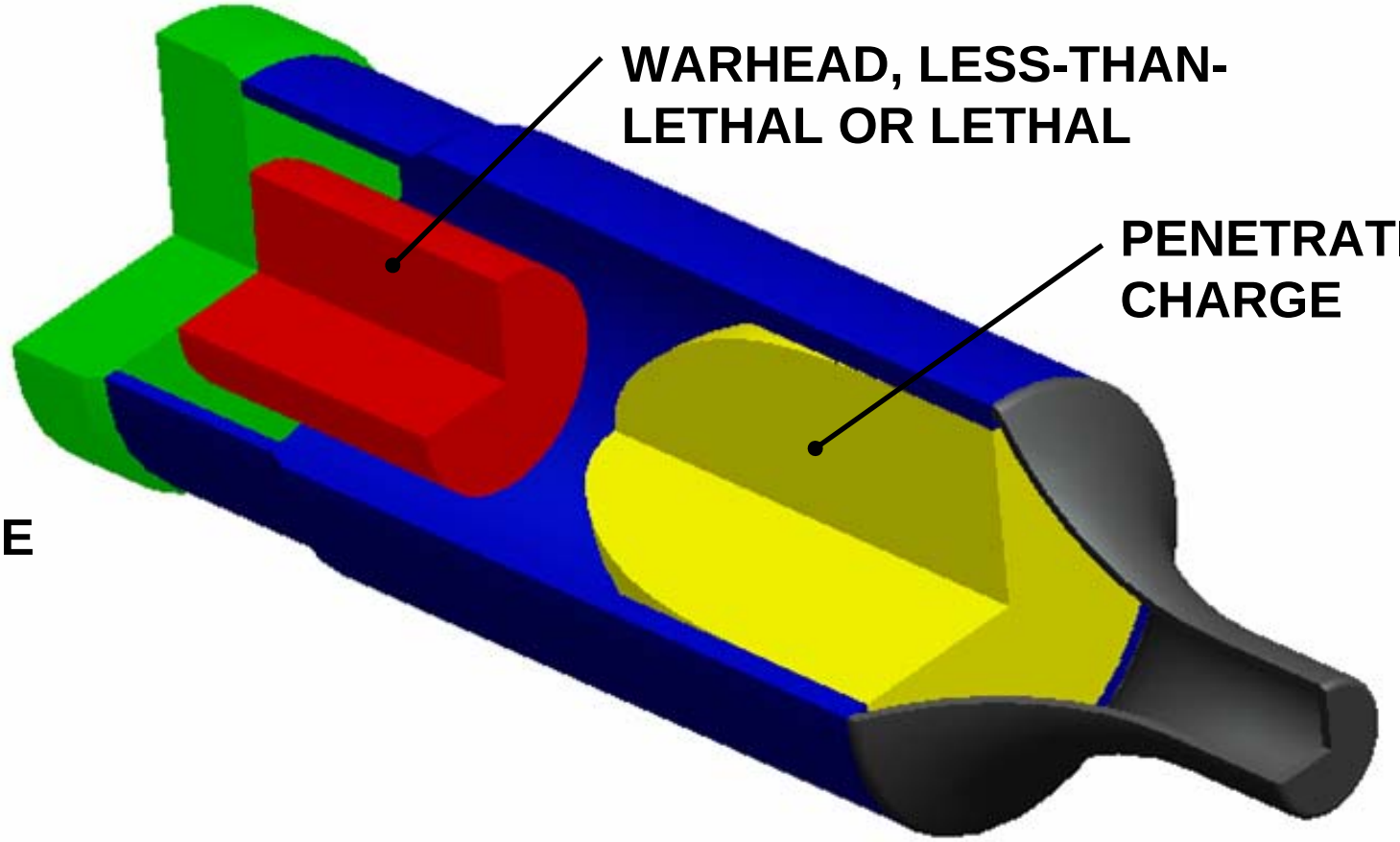
THIS CUTAWAY VIEW DEPICTS KEY COMPONENTS OF MSI's 40 mm ROUND:



Innovative Wall Penetration Munition

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Hardware Design & Testing Progress

- Penetrating charge design ***successful***
  - Consistently perforated concrete targets
  - Holes large enough for follow-through injection
- Charge design ***optimized***, using initial test results & hydrocode analysis
  - Second round of testing scheduled for **May 2007**
  - Hole-formation improvement expected
  - Added flexibility in follow-through munition design

- **Follow-thru**
  - MSI investigating flash-bang concepts
- **Fuze system**
  - Preliminary design complete
  - Evaluating components
  - Potential S&As identified, investigating designs with fuze manufacturers

Innovative Wall Penetration Munition

Mechanical Solutions, Inc.
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U.S. Army SBIR Project – ARDEC, Picatinny Arsenal

Cost and Schedule Summary **-**

Phase I:	40mm Innovative Wall Penetration Munition, $70K / 6 Months, Completed July ’05
Phase I Option:	Warhead Design: $50K / 4 Months, Completed January ’06
Phase II:	Development of Prototype Weapon, $730K / 24 Months, January ’06- January ’08
Phase III Prototype Round (Unfunded)	24-Months Total

List of Current Munition Developments

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- ✪ 40 mm Non-Lethal Round SafeShot™
- ✪ 40 mm Wall Penetrating Round DoubleShot™
- ✪ RPG-Defeat System ShotScreen™
- ✪ 12-Gauge Tagging & Marking Round SafeTag™
- ✪ 12-Gauge Door Breaching Round DoorBuster™

Please Visit MSI's Web Site,
www.MechSol.com

Call / E-mail -

Paul Boyadjis 973-326-9920 Ext.-115 pab@mechsol.com
Keith Olasin 973-326-9920 Ext.-120 kbo@mechsol.com
Eric Olson 973-326-9920 Ext.-125 ejo@mechsol.com