40 mm Less Lethal Munitions

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Virginia Beach, VA

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MSI Company Background

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

Core Competency:
Less-Lethal Munitions Design & Development
30 mm Non-Lethal SafeShot™ Round

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

- 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
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

Velocity vectors show change in vortex

Pressure distribution shown in the scale at left

Pressure distribution at 5 degrees of yaw

Chronograph

Electric solenoid for launching the projectile

Pressure Transducer

MSI’s pneumatic launcher system
Impact Depth of Various Materials

Performance comparison of various foams for ballistic clay testing
40 mm Less-Lethal Round

Impact images taken with MSI’s High Speed Camera

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

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<table>
<thead>
<tr>
<th>Impact Velocity at 50 meters</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Avg. Vel. (fps)</td>
<td>Energy (ft*lbs)</td>
</tr>
<tr>
<td>210.56</td>
<td>78.2</td>
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</tbody>
</table>

*M1006 at 10 meters has 67 ft*lbs of energy
75 Meter Dispersion Test

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

<table>
<thead>
<tr>
<th>Impact Velocity at 75 meters</th>
<th>Avg. Vel. (fps)</th>
<th>Energy (ft*lbs)</th>
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<tbody>
<tr>
<td></td>
<td>180.33</td>
<td>57.4</td>
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</tbody>
</table>

*M1006 at 10 meters has 67 ft*lbs of energy
Ballistic Clay Testing

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)

<table>
<thead>
<tr>
<th>Averages based on 5 shots</th>
<th>Muzzle Vel. (fps)</th>
<th>Depth (inch)</th>
<th>Diameter (inch)</th>
<th>Muzzle Energy (ft*lbs)</th>
<th>% Away from Limit (1.732” NL Limit)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>238.8</td>
<td>1.685</td>
<td>2.28</td>
<td>100.8</td>
<td>-2.74%</td>
</tr>
</tbody>
</table>
Impact Energy vs. Range

MSI’s projectile has higher initial impact energy and maintains velocity downrange.
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**

**CHALLENGE:** ACCESS EMLACED 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
Innovative Wall Penetration Munition

“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
Innovative Wall Penetration Munition

**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\textsubscript{m}
CONCEPT 1 –
OPERATION OF THE INNOVATIVE WALL PENETRATION MUNITION

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

Energetic material ignites inside or near exit opening of wall perforation
Energetic material emerges from wall

Exterior  Structure  Wall  Interior Space
CONCEPT 2 -
OPERATION OF THE INNOVATIVE WALL PENETRATION MUNITION

- Perforating charge detonates
- Warhead enters perforation in structure wall

Warhead emerges from target wall

Exterior

Interior Space

Structure Wall
Innovative Wall Penetration Munition

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

This cutaway view depicts key components of MSI’s 40 mm round:

- WARHEAD, LESS-THAN-LETHAL OR LETHAL
- PENETRATING CHARGE
- BASE
- WINDSHIELD
Innovative Wall Penetration Munition

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
Innovative Wall Penetration Munition

- **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

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

- 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™


Call / E-mail -

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