RDECOM

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ARMAMENT RESEARCH, DEVELOPMENT AND ENGINEERING CENTER
PICATINNY ARSENAL, NJ

TECHNOLOGY DRIVEN. WARFIGHTER FOCUSED.

Effects of Small Caliber Munitions Through Intermediate Barriers

May 2008

Jeremy Lucid – US Army - ARDEC

Introduction

- Can fielded ammunition meet the Needs of the war fighter?
- How well do 5.56mm projectiles penetrate automobiles?
- What are the penetration capabilities of small caliber ammunition against intermediate barriers?

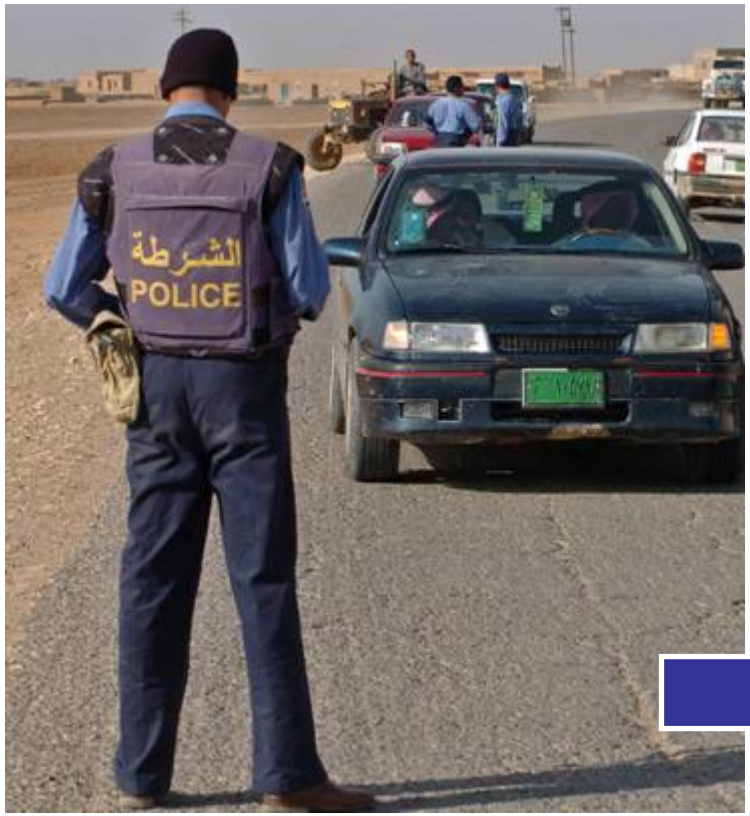
Typical Intermediate Barriers

Concrete Wall

Insurgent Vehicle

This vehicle ran a checkpoint.
Could this have been prevented?

Vehicle Checkpoint

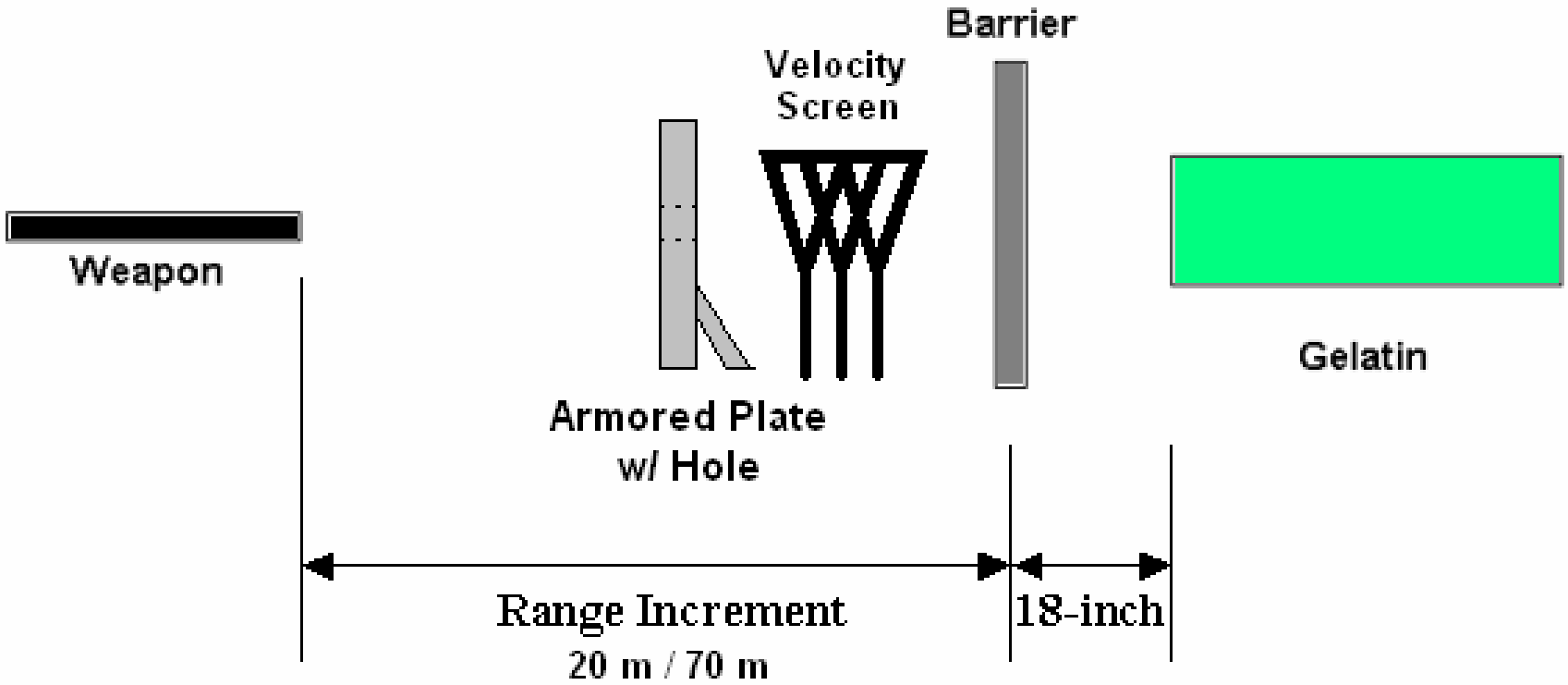


Lab Setup

Phase I – Shot Matrix

Weapons → Ammunition	M16 (5.56mm)	M4 (5.56mm)	M240 (7.62mm)
M193 (5.56mm)	Intermediate Barriers • No Barrier (Baseline) • Windshields • Simulated Car Doors		
M855 (5.56mm)			
MK262 (5.56mm)			
M80 (7.62mm)			

Phase I – Range Setup



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Phase I – Barrier Setup

90˚ Steel Plates

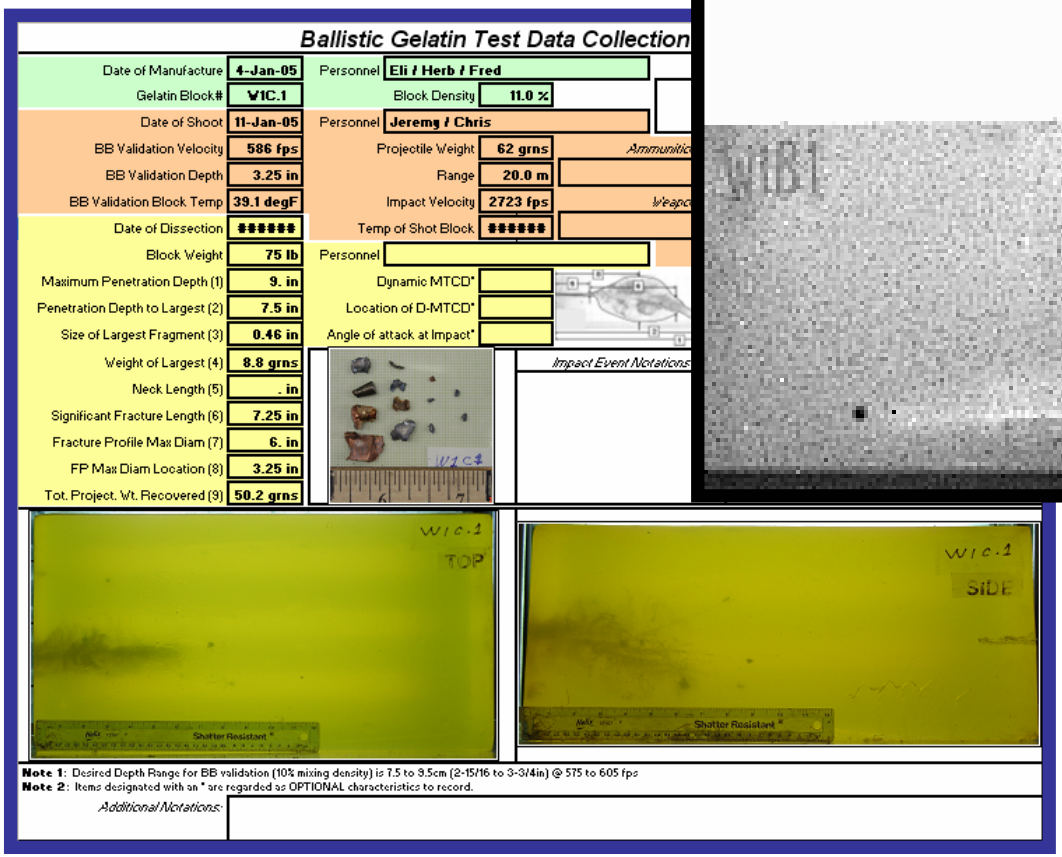
45˚ Steel Plates

Phase I – Barrier Setup

90˚ Windshield

45˚ Windshield

Phase I – Data Extraction

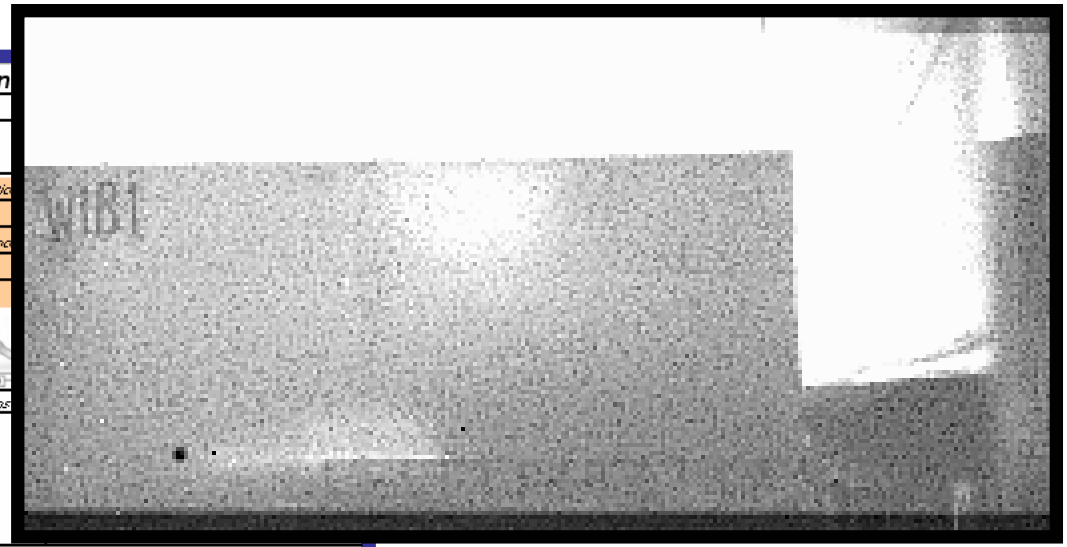


Ballistic Gelatin Test Data Collection

Date of Manufacture	4-Jan-05	Personnel	Eli / Herb / Fred		
Gelatin Block#	W1C.1	Block Density	11.0 %		
Date of Shoot	11-Jan-05	Personnel	Jeremy / Chris		
BB Validation Velocity	586 fps	Projectile Weight	62 grns	Ammunitio	
BB Validation Depth	3.25 in	Range	20.0 m		
BB Validation Block Temp	39.1 degF	Impact Velocity	2723 fps	Weapo	
Date of Dissection	######	Temp of Shot Block	######		
Block Weight	75 lb	Personnel			
Maximum Penetration Depth (1)	9. in	Dynamic MTCD*			
Penetration Depth to Largest (2)	7.5 in	Location of D-MTCD*			
Size of Largest Fragment (3)	0.46 in	Angle of attack at Impact*			
Weight of Largest (4)	8.8 grns			Impact Event Notations	
Neck Length (5)	. in				
Significant Fracture Length (6)	7.25 in				
Fracture Profile Max Diam (7)	6. in				
FP Max Diam Location (8)	3.25 in				
Tot. Project. Wt. Recovered (9)	50.2 grns				

Note 1: Desired Depth Range for BB validation (10% mixing density) is 7.5 to 9.5cm (2-15/16 to 3-3/4in) @ 575 to 605 fps
Note 2: Items designated with an * are regarded as OPTIONAL characteristics to record.

Additional Notations:



- **Recovered Projectile Parameters**
- **High Speed Video**

- **Gelatin Damage Parameters**

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Phase I – EDR Analysis

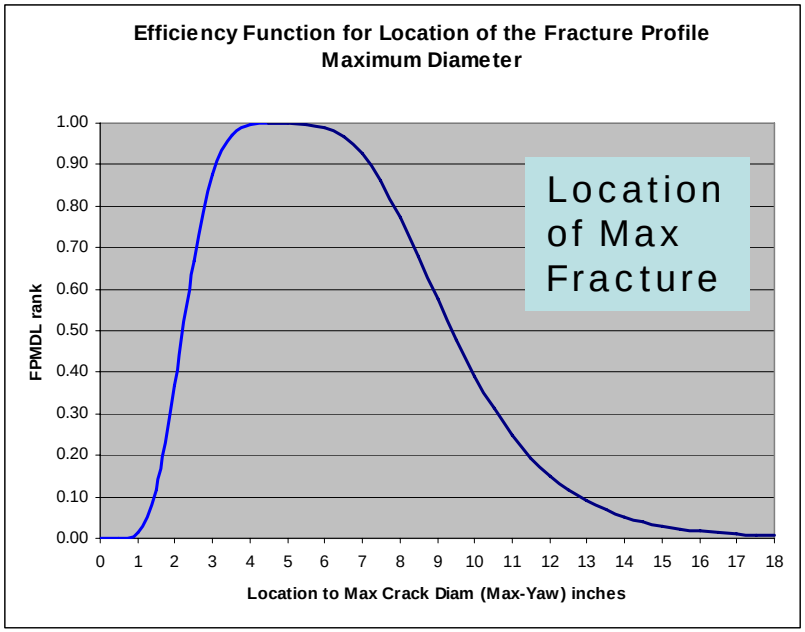
- Effective Damage Rating (EDR) is an abbreviated ranking system designed to quickly estimate the terminal performance of small caliber ammunition against human threats.
- Methodology is defined in Technical Report ARAET-TR-06013

Phase I – EDR Analysis

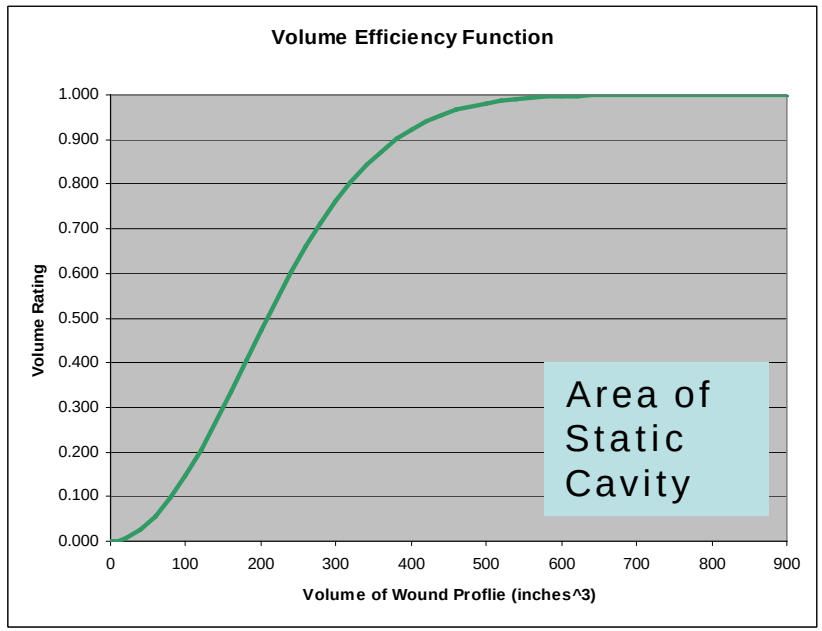
- EDR values range from zero to one
  - (1) One is Good
  - (0) Zero is Bad
- EDR is an average of four rankings
  - EDR-1 *Rapid Effects/ Location of Damage*
  - EDR-2 *Quantity of Potential Damage*
  - *EDR-3 Adequate Penetration*
  - *EDR-4 Potential Engagements of Vital Organs*

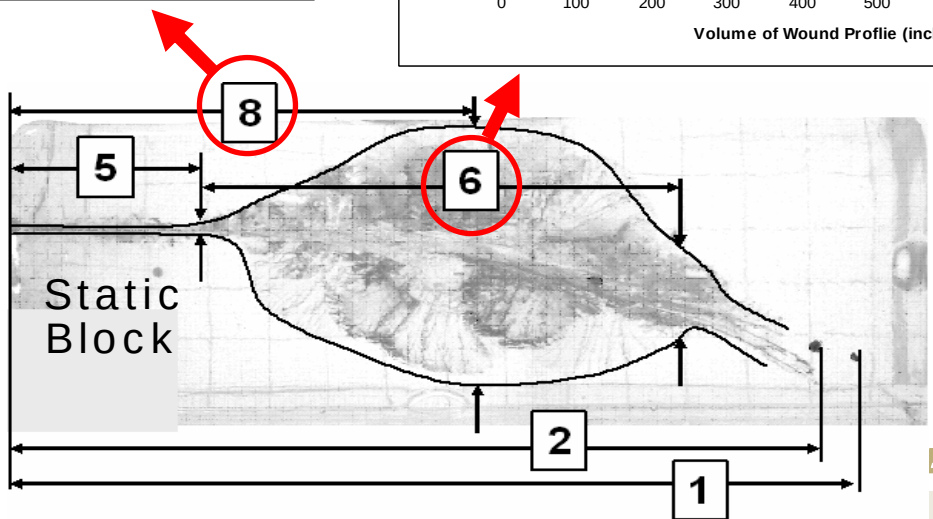
Phase I – EDR Analysis

EDR-1 *Rapid Effects/ Location of Damage* **25%**



EDR-2 *Quantity of Potential Damage* **25%**





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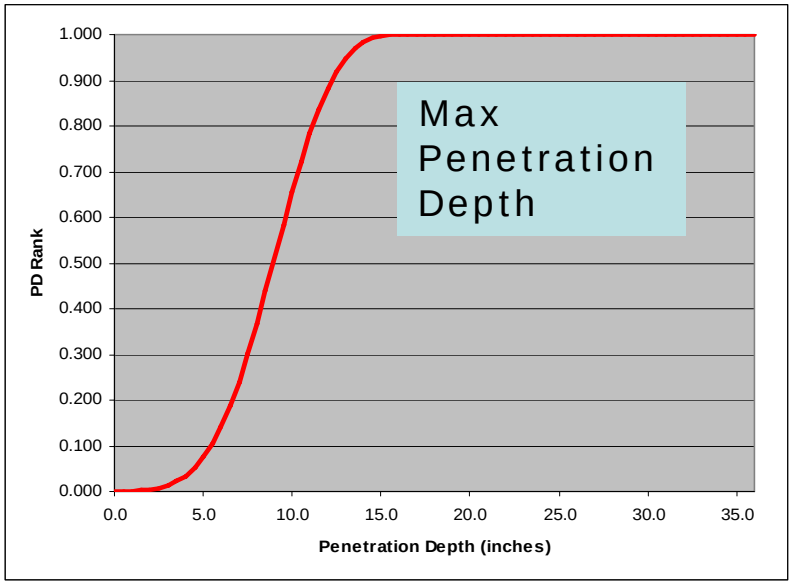
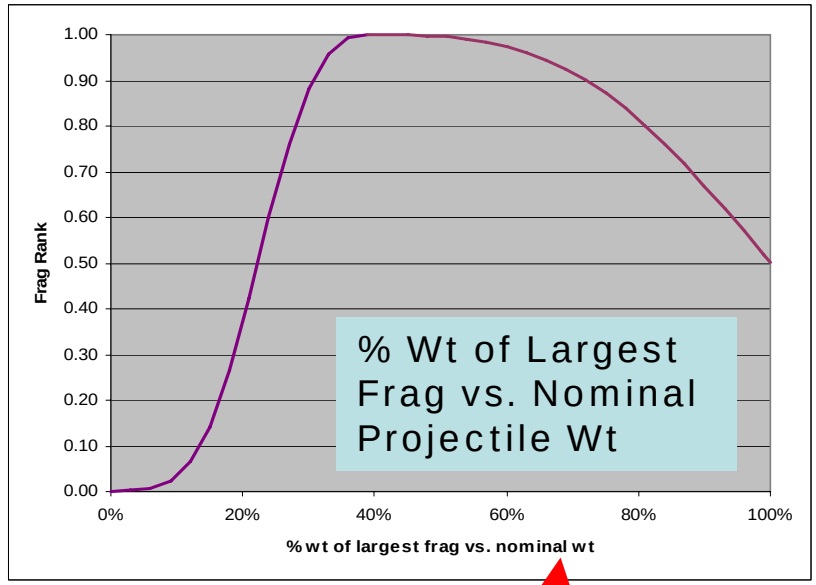
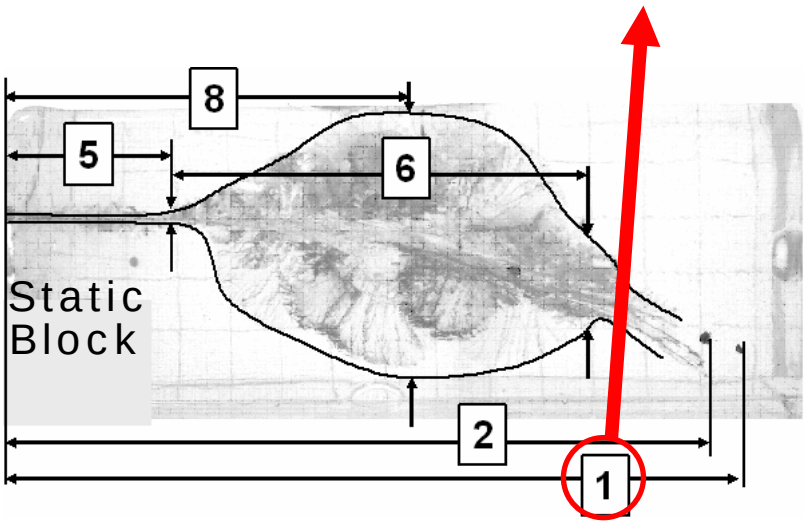
Phase I – EDR Analysis

EDR-3 Adequate Penetration **25%**



EDR-4 Potential Engagements of Vital Organs **25%**



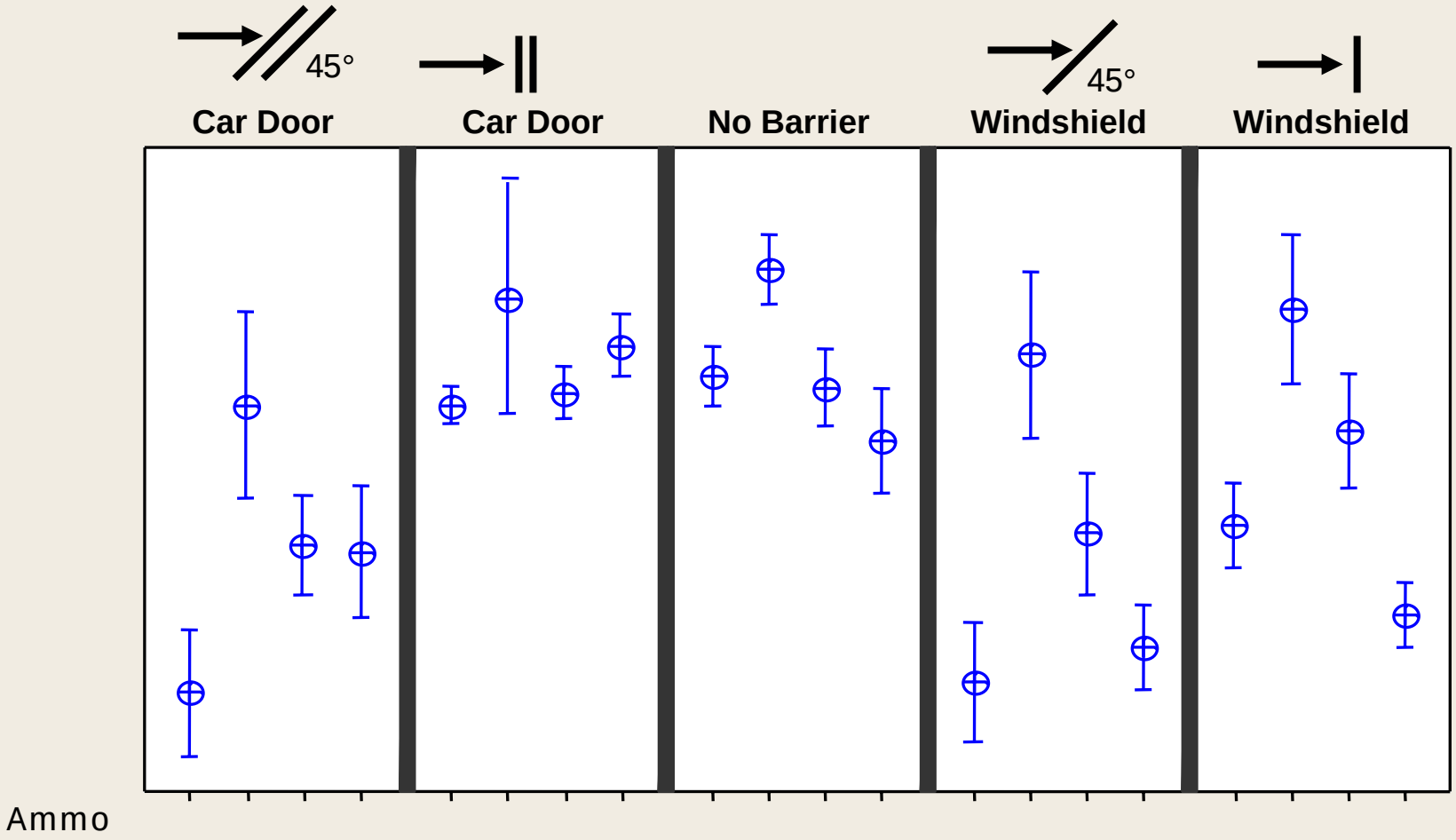


Bullet Fragments

Phase I – Results

Average XYZ (Range: 20 m - 70 m)

95% CI for the Mean



Phase II - Overview

- Evaluate terminal effects of 1,600 rounds of 5.56mm & 7.62mm ammunition through:
  - Automobile windshields at steeper angles
  - Simulated truck doors w/ increased shell thickness
  - Concrete blocks
- Establish quick go/no gages for intermediate barriers to assist in assessing the threat

Phase II - Test Setup

Weapons:

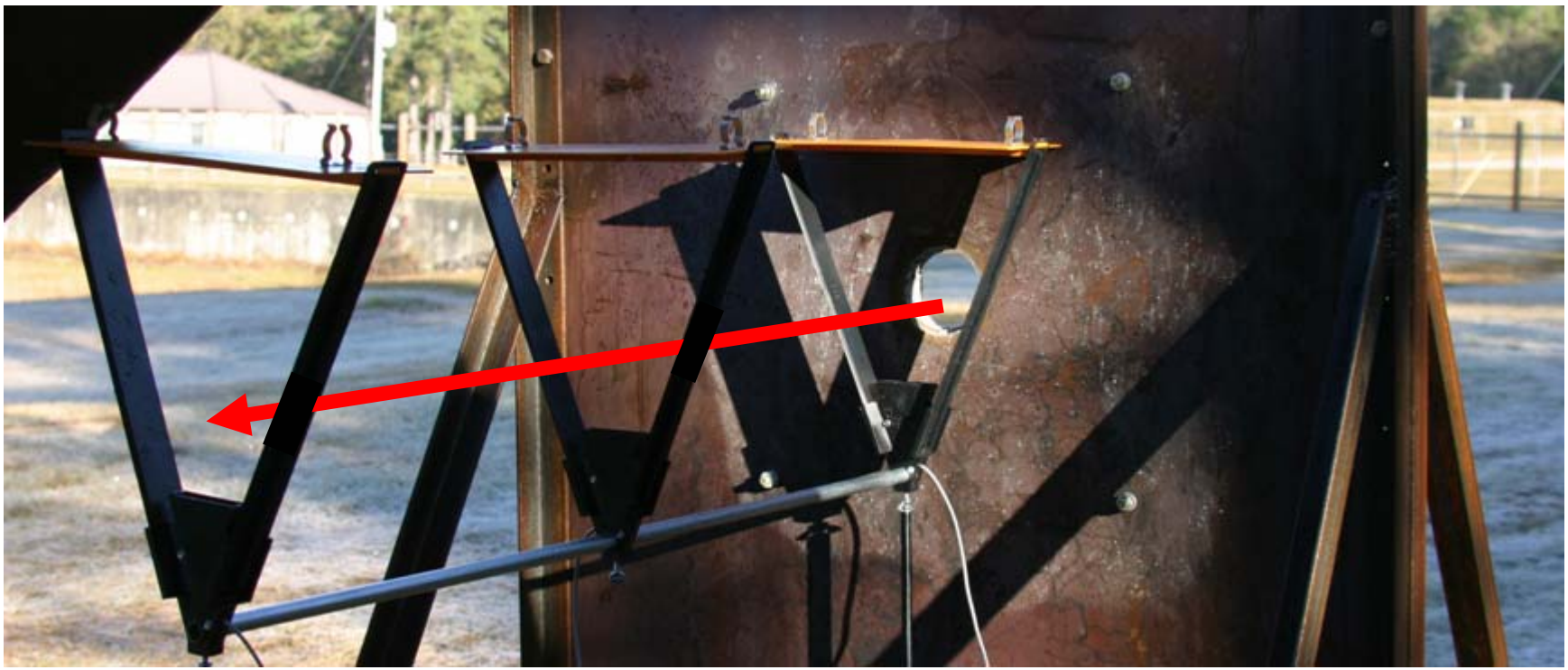
- M4
- M16
- M249
- M24
- M240

Ranges:

- 75m
- 200m

Phase II - Test Setup

5.56mm Ammo	7.62mm Ammo
M193 M855 MK262 M995	M118LR M80



Automobile Windshields

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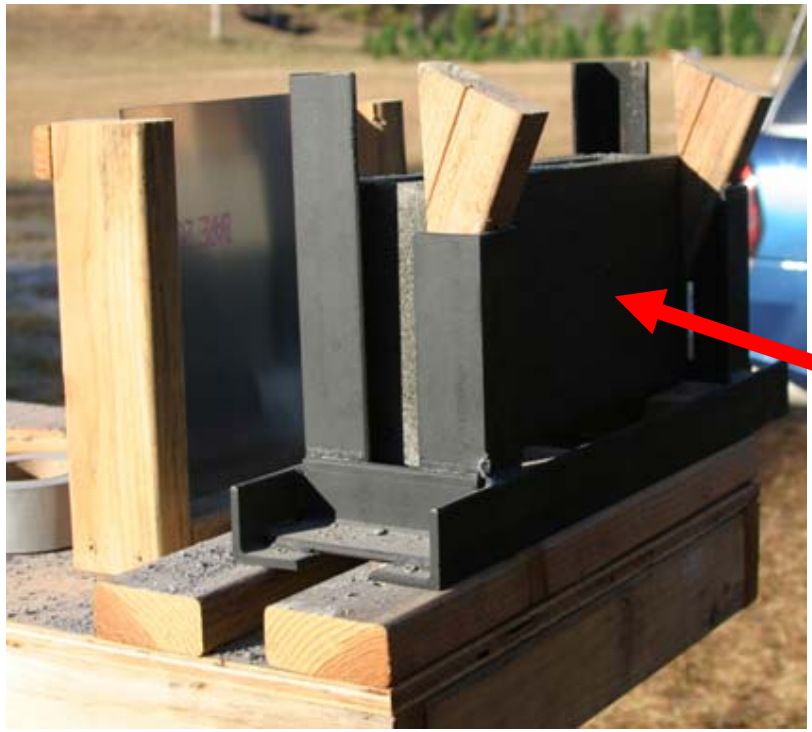
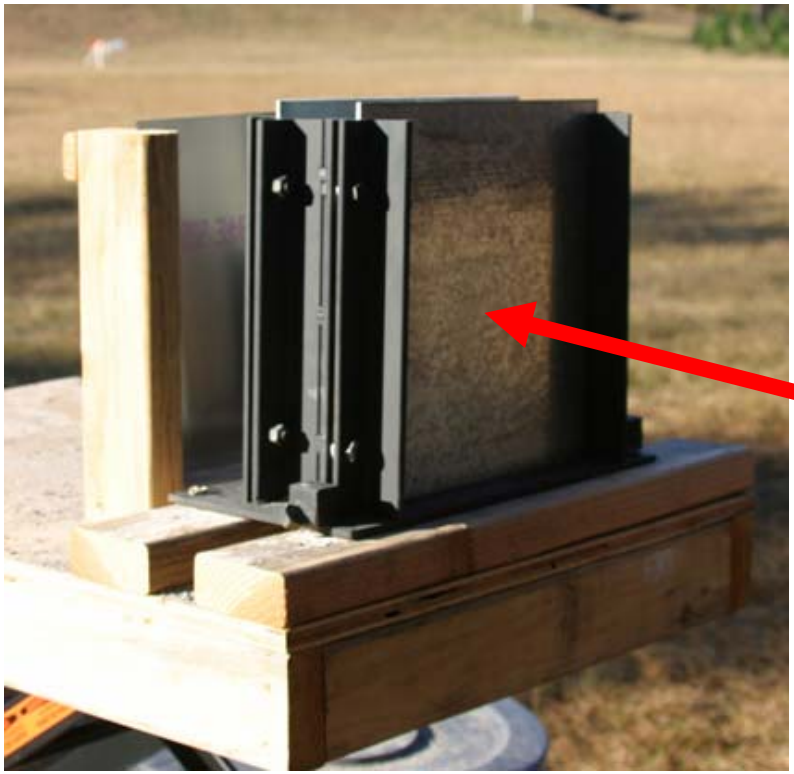
Concrete & Steel

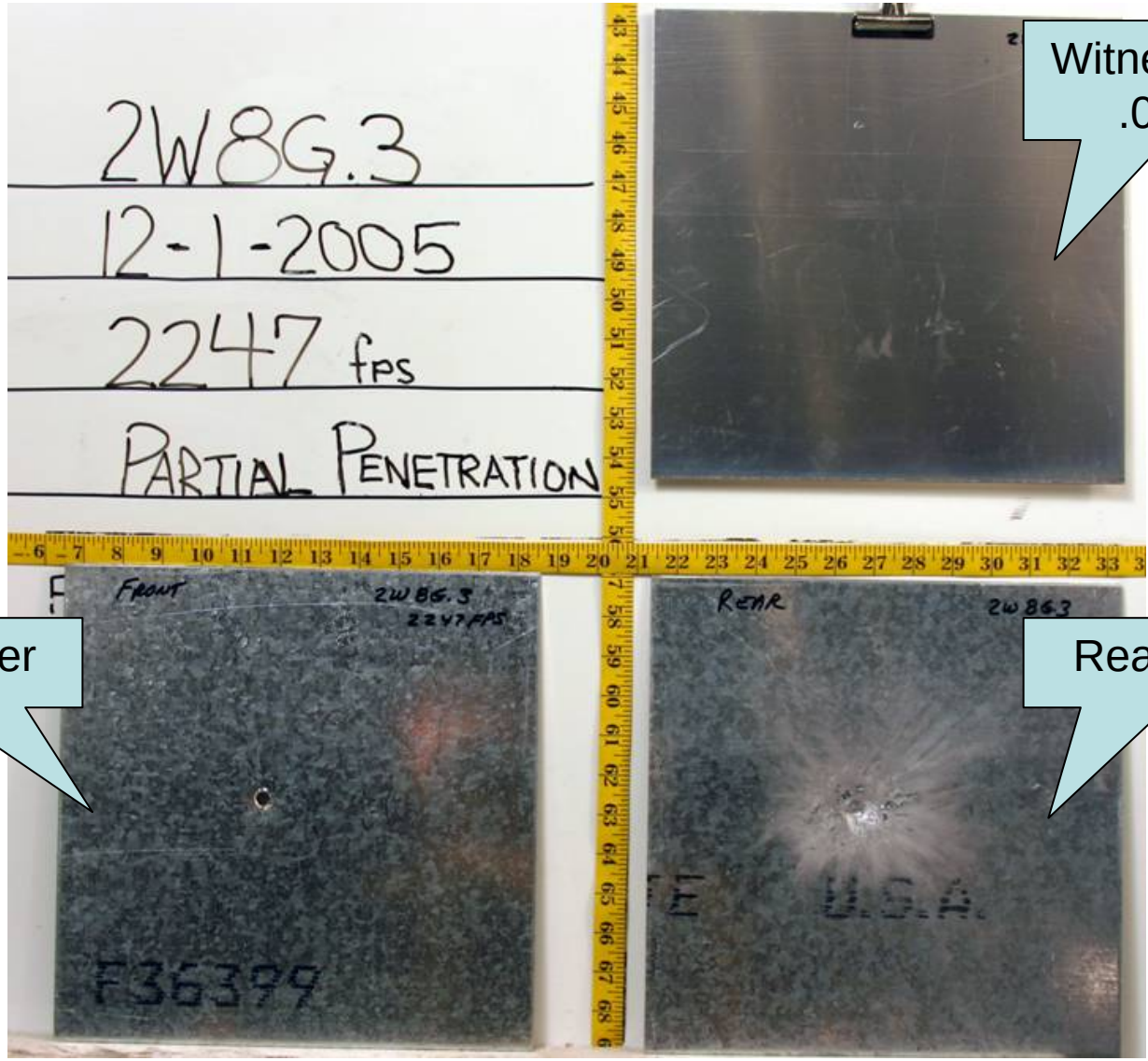
Concrete ➔





➔ Steel

Data Collection



Witness Sheet
.020" Al

Front Barrier

Rear Barrier

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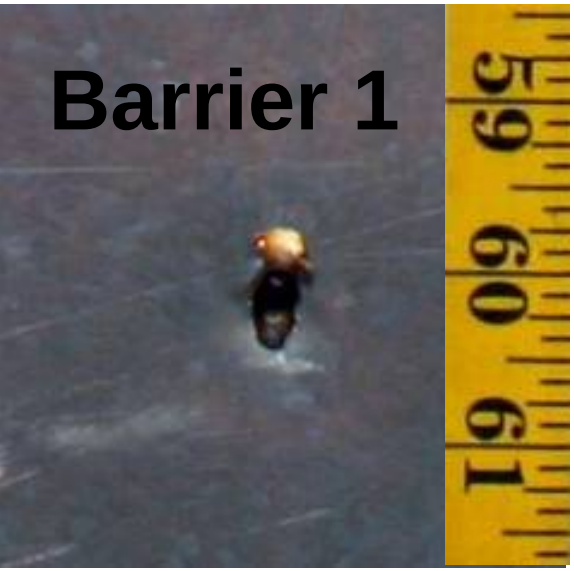
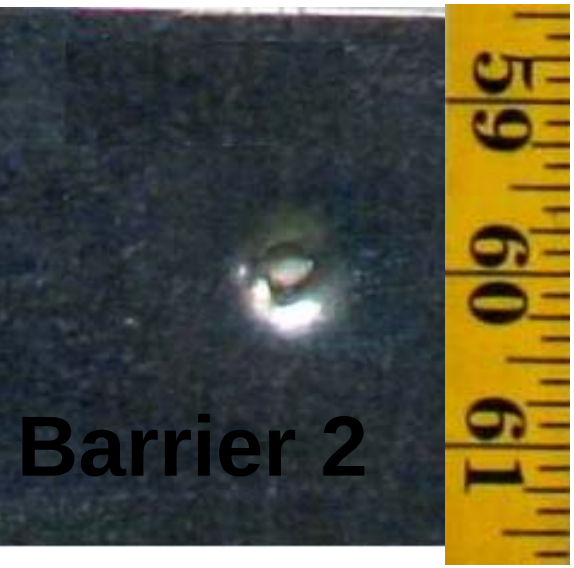
Penetration Assessment



Partial Penetration



Full Penetration

Penetration Assessment of Munitions (PAM) Charts

RND XYZ - XX grain

	Windshield	Heavy Truck Door		Concrete Façade	
Weapon/ Range	**Worst Case**	**Head On**	**Angle**	**4" Hollow**	**4" Filled**
Gun 1 - Range 1	**1**	**1**	**2**	**1**	**2**
Gun 1 - Range 2	**1**	**2**	**2**	**2**	**3**
Gun 2 - Range 1	**1**	**2**	**2**	**1**	**2**
Gun 2 - Range 2	**1**	**2**	**2**	**1**	**3**

1	Full Penetration - Minimum # of Shots Required to Penetrate Barrier (80% of the rounds fired were able to penetrate the barrier on the first shot)
2	Partial Penetration - Multiple Shots Required To Penetrate Barrier
3	No Penetration - Maximum # of Shots Required To Penetrate Barrier (80% of the rounds fired were unable to penetrate the barrier on the first shot)

Conclusion

- Provided a quick assessment of currently fielded ammunition
- Determined effectiveness through light intermediate barriers found in field
- Compiled all data for future testing and modeling efforts
- Publishing technical report

Contact Information

Questions?

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