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

September 2008

Chris Gandy & 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

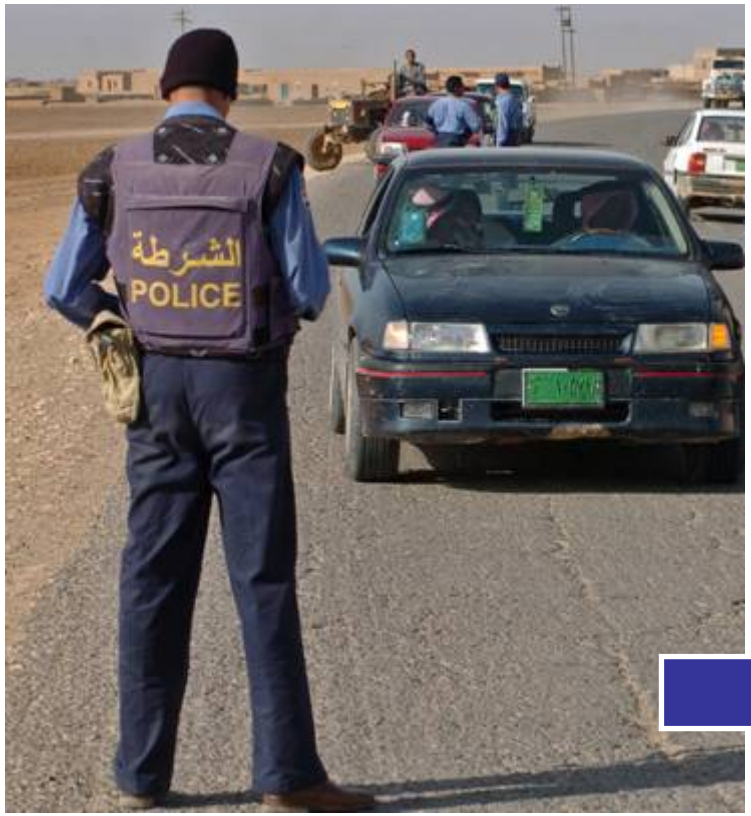
Concrete Wall

Insurgent Vehicle

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

Reality ➔ Model

Vehicle Checkpoint



Lab Setup

Phase I – Shot Matrix

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

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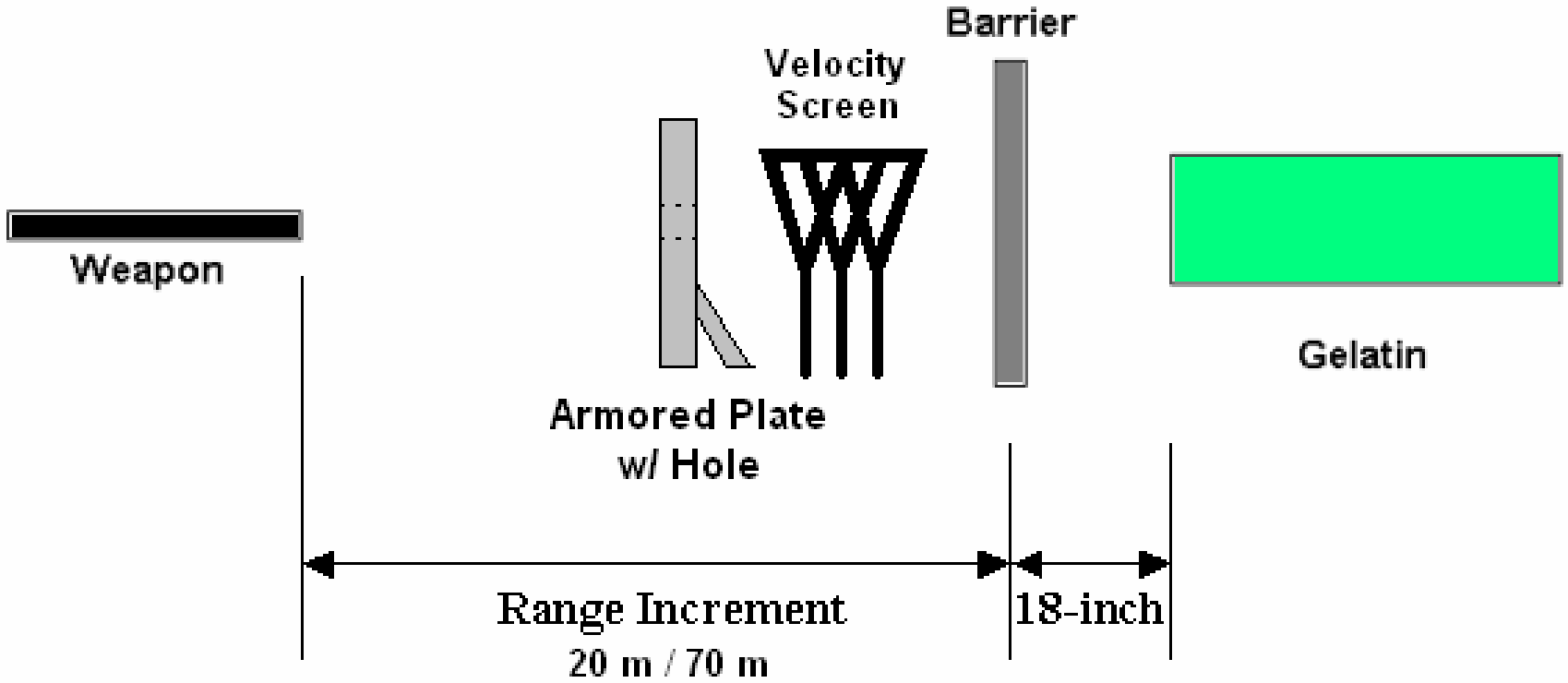
Phase I – Range Setup



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Phase I – Barrier Setup

90˚ Steel Plates

45˚ Steel Plates

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Phase I – Barrier Setup

90˚ Windshield

45˚ Windshield

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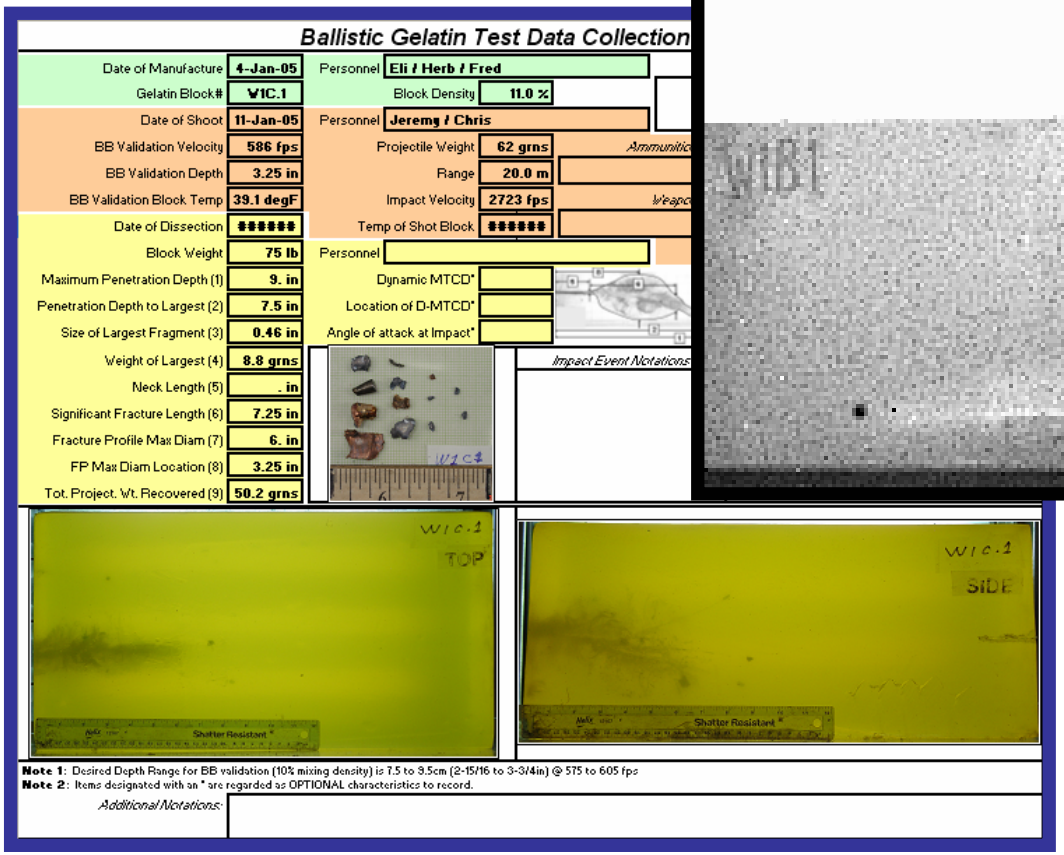
Phase I – Data Extraction

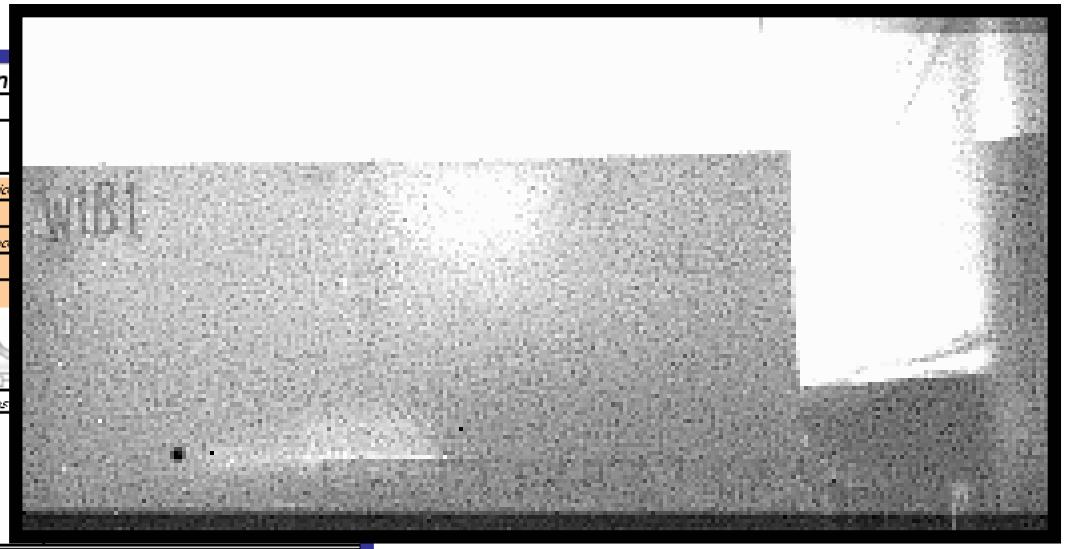


Ballistic Gelatin Test Data Collection

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

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Phase I – EDR Analysis

- EDR values range from zero to one
  - (1) One is Good
  - (0) Zero is Bad
- There are four different EDR 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*
- Average of all four EDR values was used

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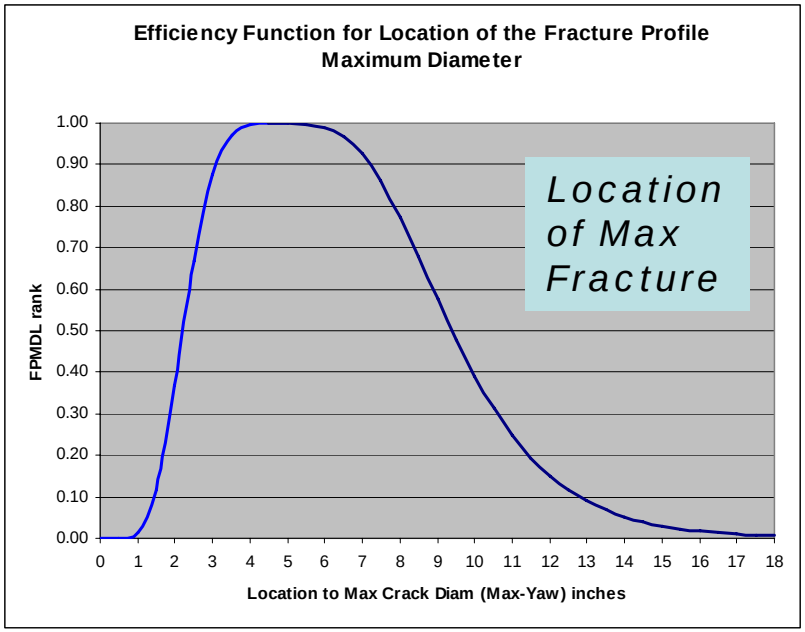
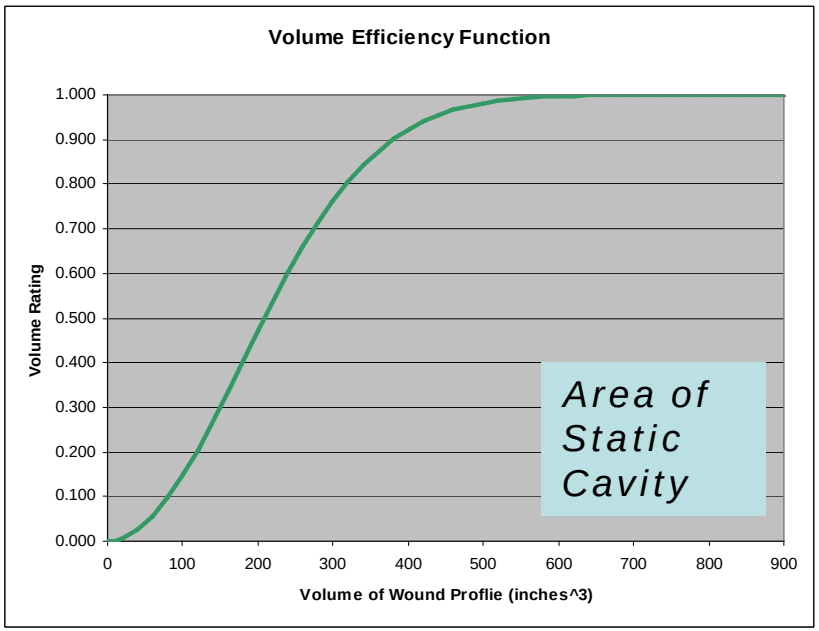
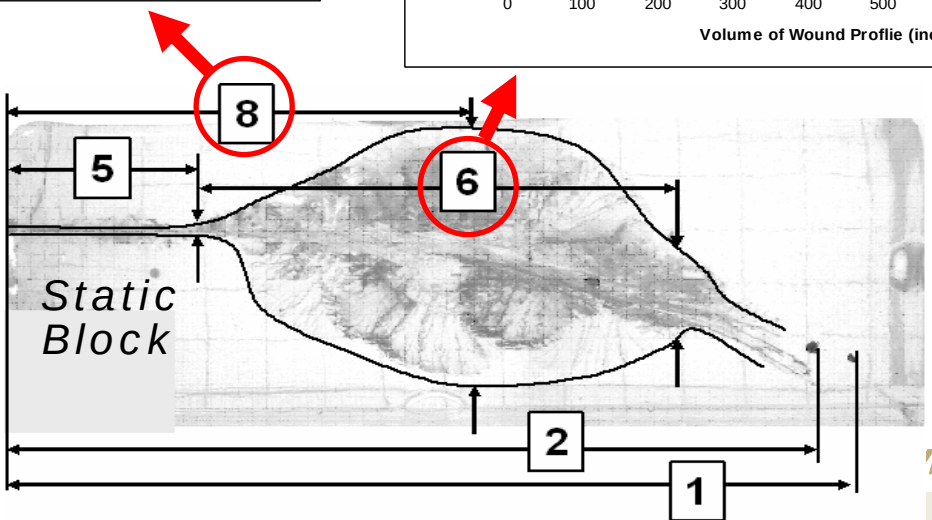
Phase I – EDR Analysis

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



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





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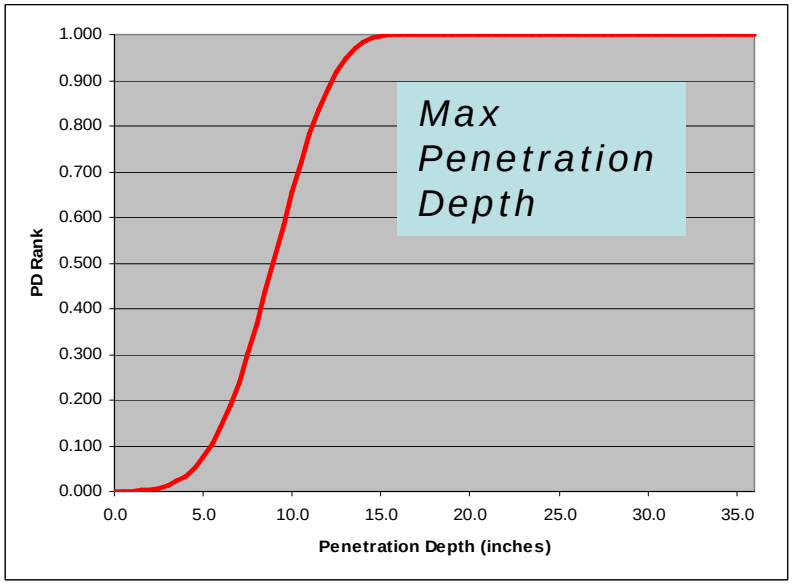
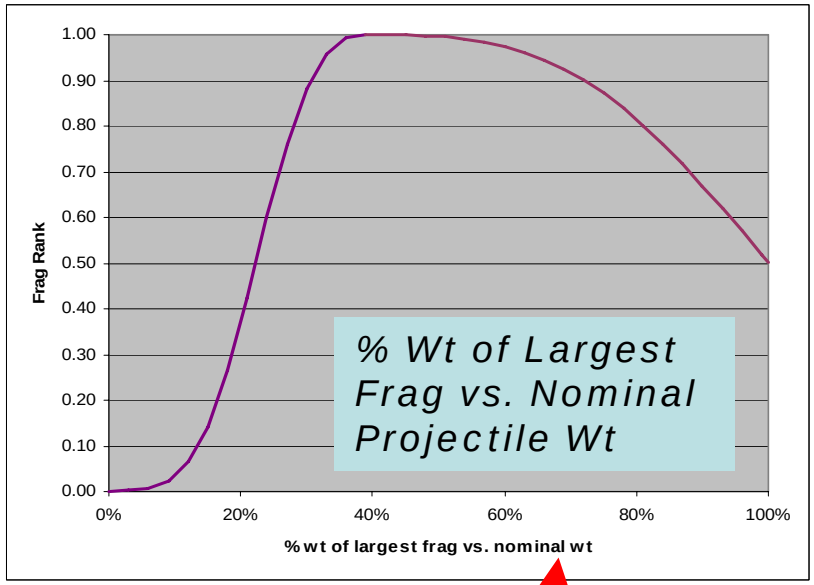
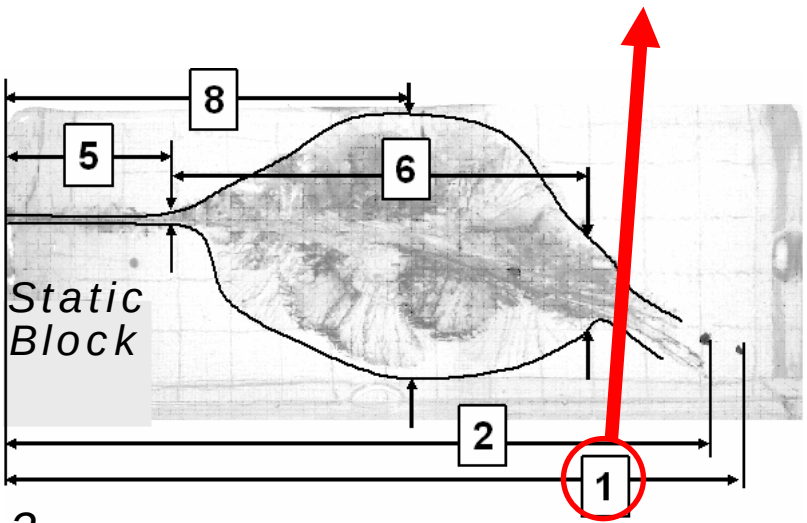
Phase I – EDR Analysis

EDR-3 Adequate Penetration → **25%**



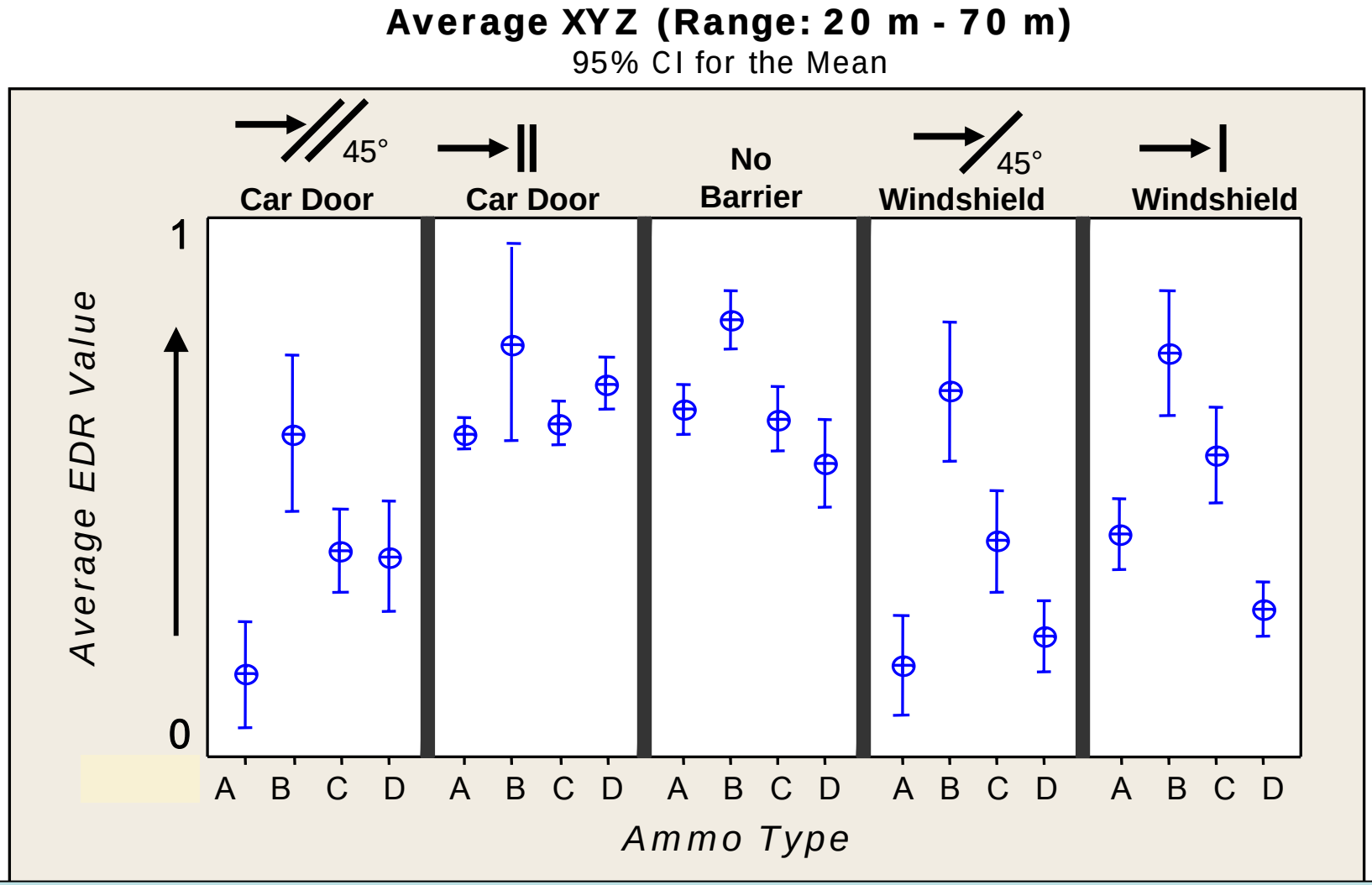
EDR-4 Potential Engagements of Vital Organs → **25%**





Bullet Fragments

Phase I – Results



Higher Average EDR Value = Better Post-Barrier Effectiveness

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

USAMU – Ft Benning

Weapons:

- M4
- M16
- M249
- M24
- M240

Ranges:

- 75m
- 200m

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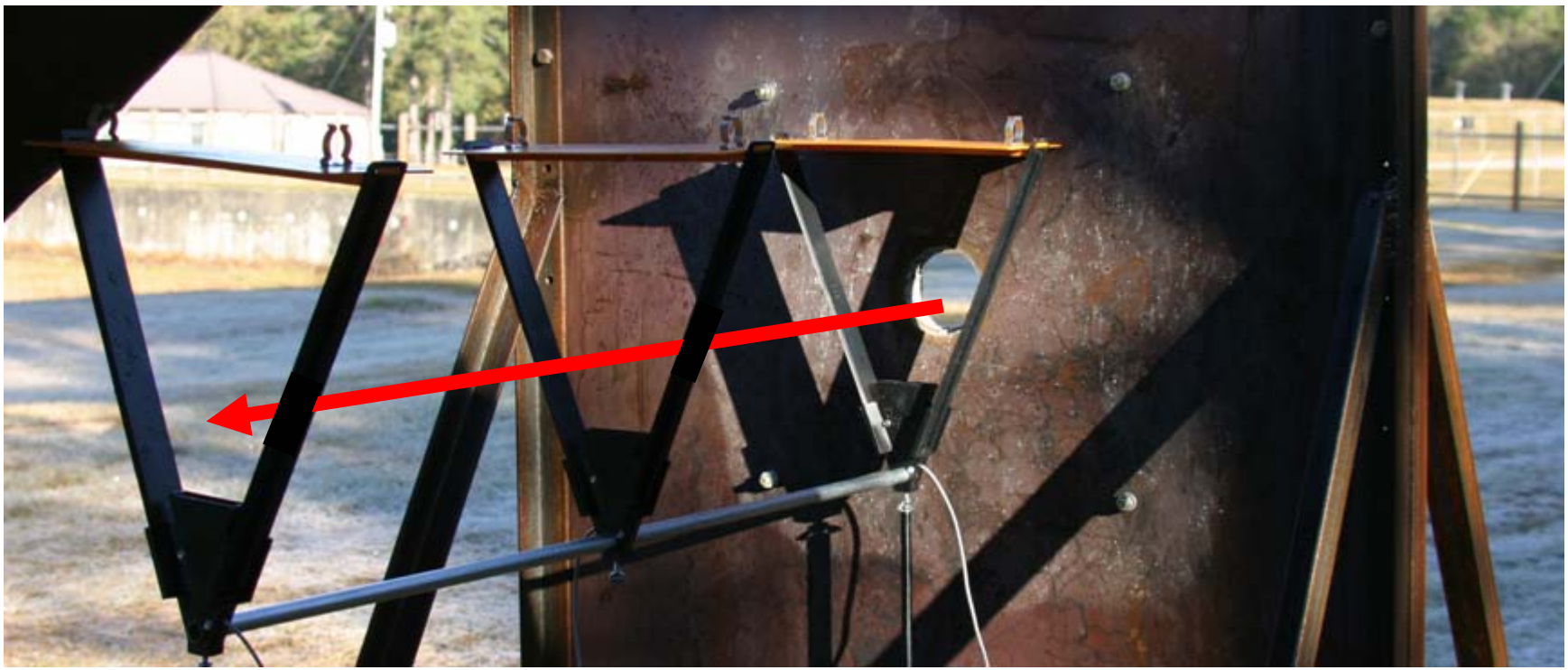
Phase II - Test Setup

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



Automobile Windshields

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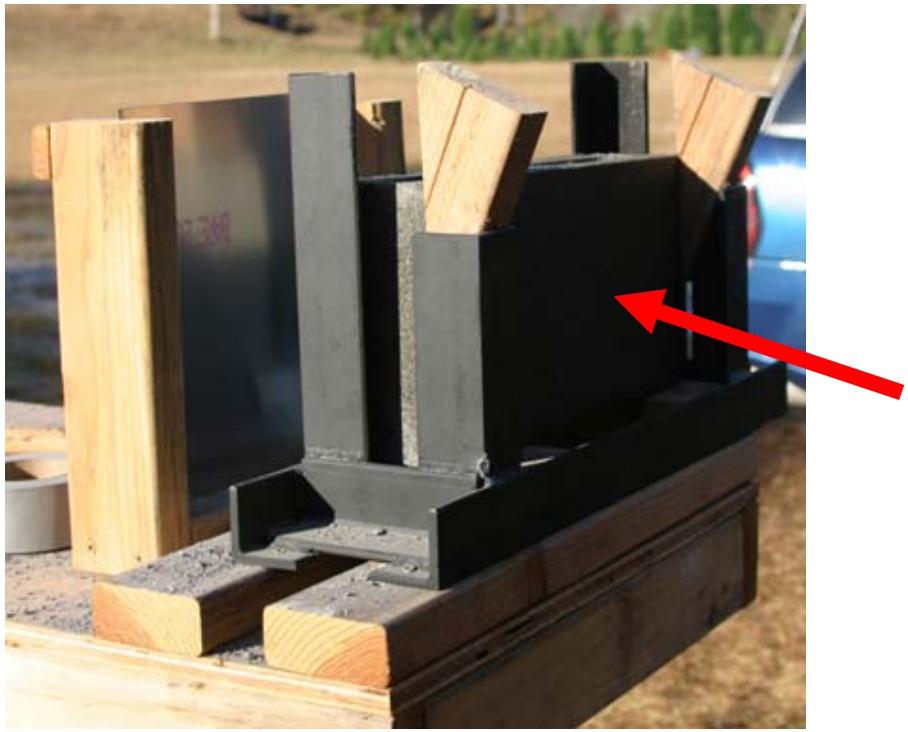
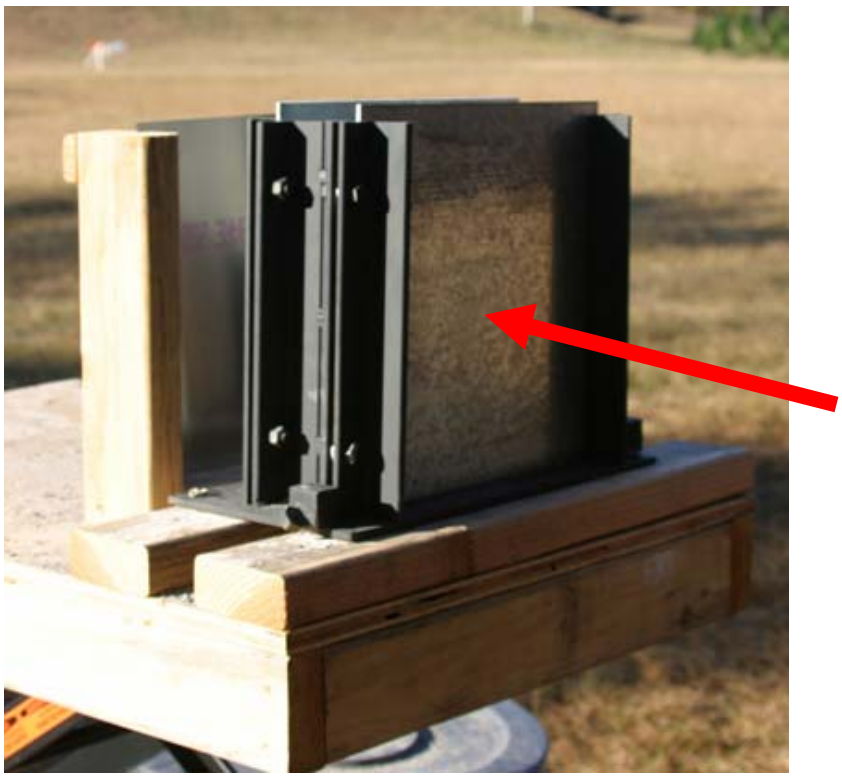
Concrete & Steel

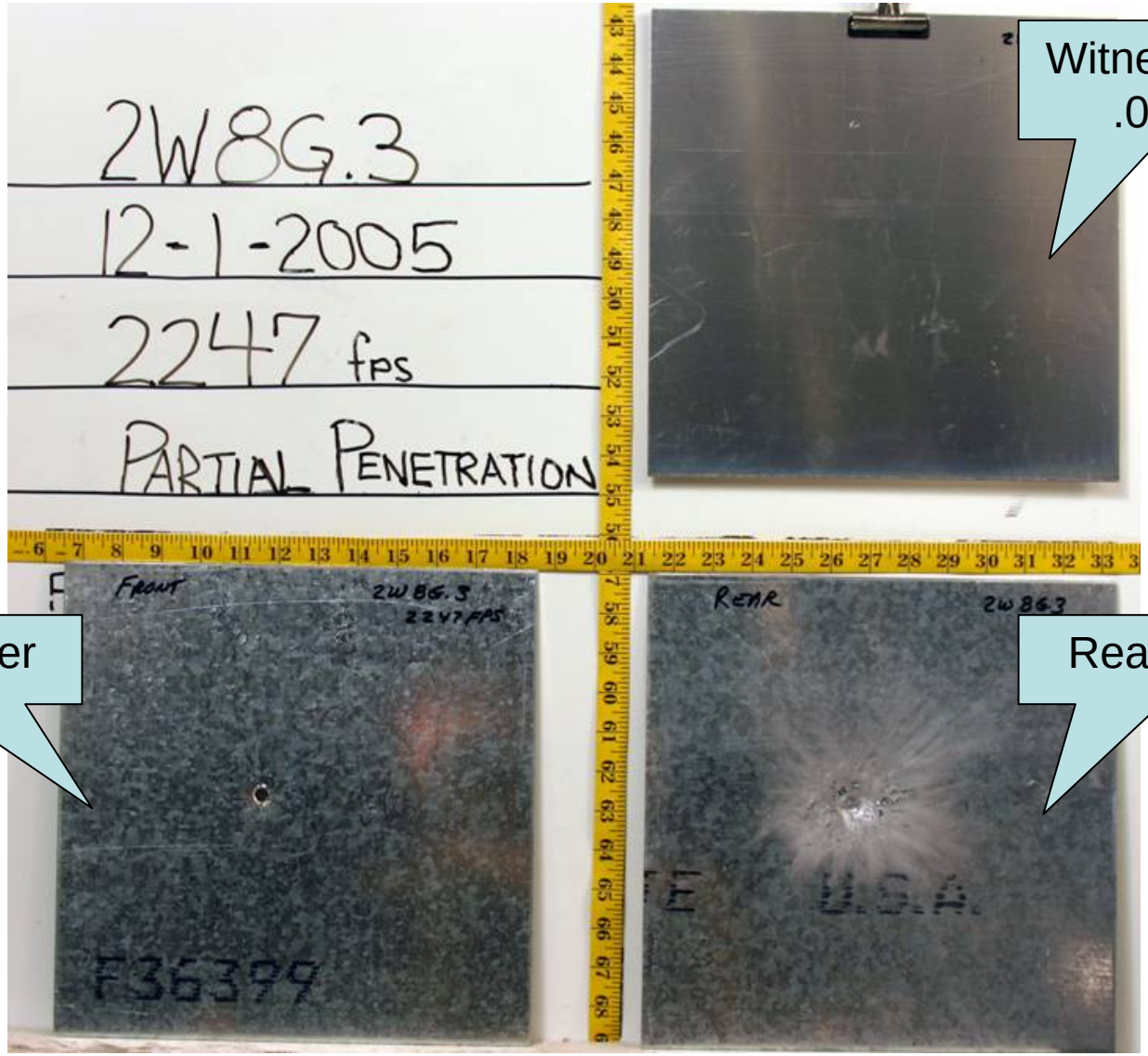
Concrete ➔





🡐 Steel

Data Collection



Witness Sheet
.020” Al

Front Barrier

Rear Barrier

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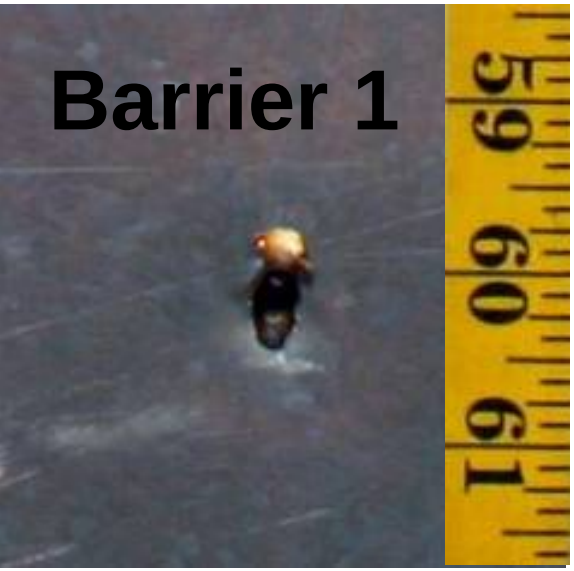
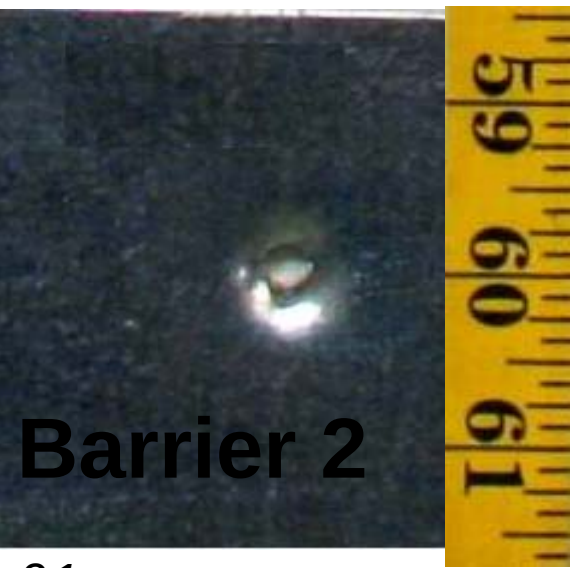
Penetration Assessment



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)

Quick assessment of penetration capability across multiple barriers and ranges.

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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
- Technical Report ARAET-TR-07030

Requests for this document:

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Contact Information

Questions?

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