



TACOM

Lethality, Survivability, Mobility and
Sustainment for America's Army

Long Standoff Demolition Warheads for Armor, Masonry and Concrete Targets

Mines, Demolition and Non-Lethal Conference
4 June 2002

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Warhead Group

Tank-automotive & Armaments COMmand



Outline

- Introduction
- Warhead tests against
 - Armor
 - Brick walls
 - Single and Double reinforced concrete walls
 - Heavy reinforced concrete columns
- Other Warhead Designs
 - Multiple EFP Warheads
 - Fence Piercing Warheads
 - Warheads with more energetic Explosive
- Summary



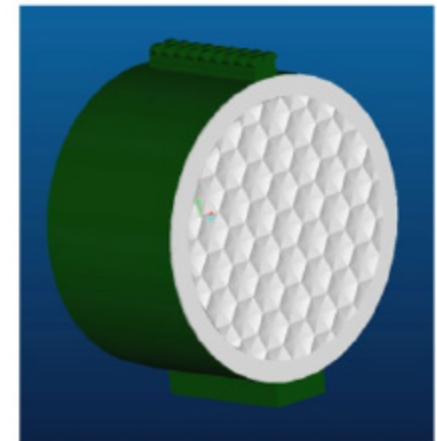
Objective: Develop a family of C-4 packed long standoff Demolition Warhead to defeat armor, masonry and concrete targets

Approach: Use Explosively Formed Penetrator (EFP) Warhead Technology



EFP Warheads in the M303 SDK

Small, Med & X-Large
Single EFP Warheads



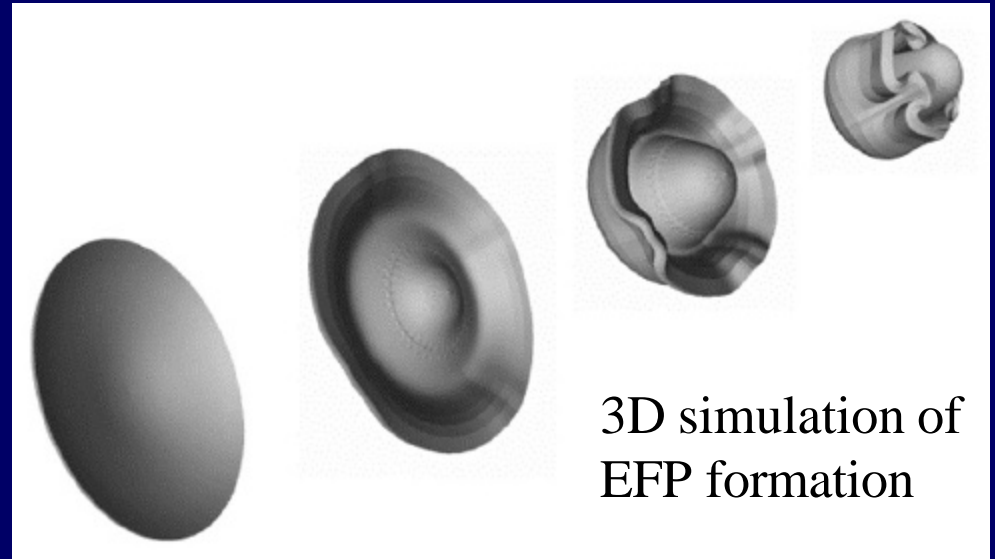
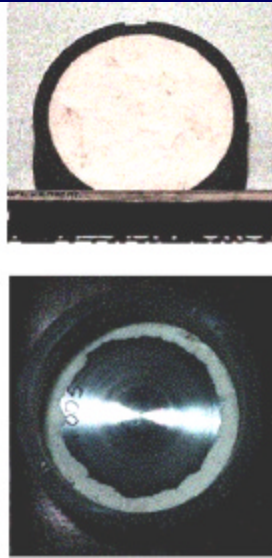
Medium MEFP Warhead

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Explosively Formed Penetrator (EFP) Warhead

Handpacked C-4



3D simulation of
EFP formation

Housing:

Glass filled Polyurethane

Explosive:




Composition C-4

EFP Liner:

Iron



EFP Warheads

Warhead Dia. (in.)	Weight (lbs.)	C-4 (lbs.)	Hi-speed photo
2	0.35	0.2	
3	1.14	0.6	
4	2.76	1.4	
6	9.5	5.4	
7	15.1	8.5	
8	19.2	11.2	
12	83.2	47.6	

Small

Medium

X-Large

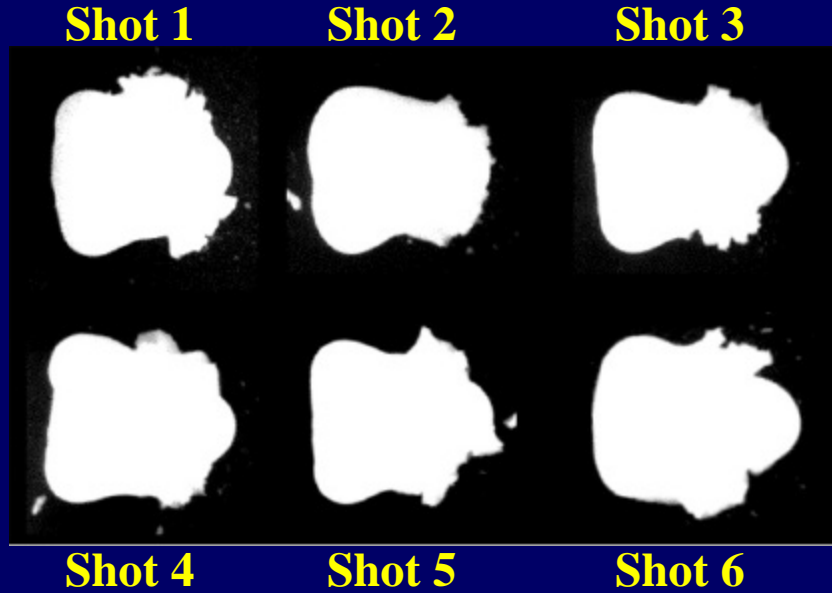
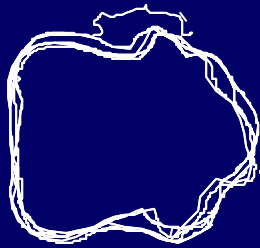
Material eroded during recovery

EFP recovered



Medium SDK EFP Warhead data

6 X-rays
Overlay

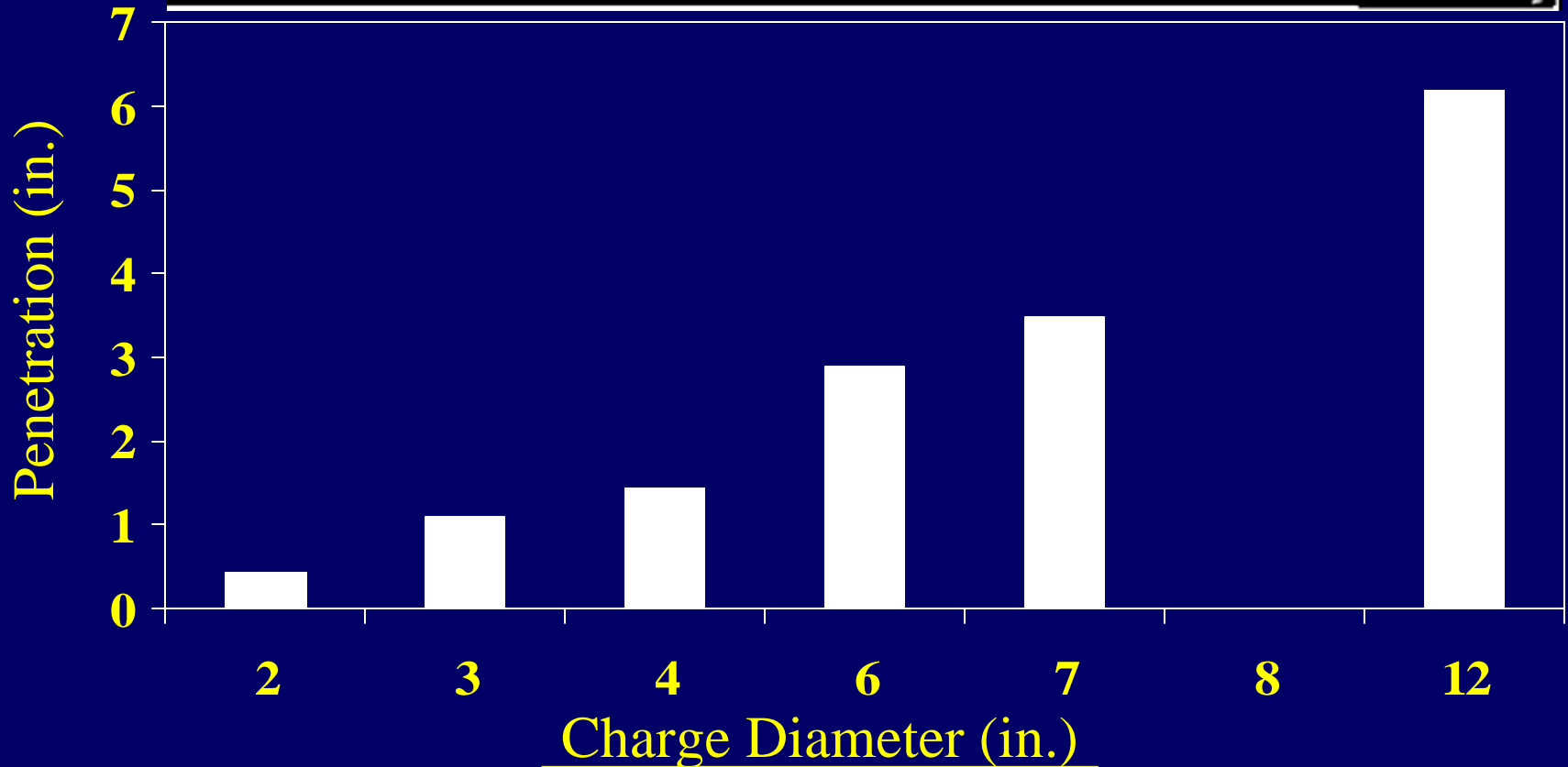


Range (ft.)	50	163	196.5*	229	327	491
No. of tests	17	3	2	3	5	1
Avg. radial miss distance (in.)	2.7	14.6	6.3	10.7	16.8	9.1

*50 meters



Armor penetration data at 50 ft.



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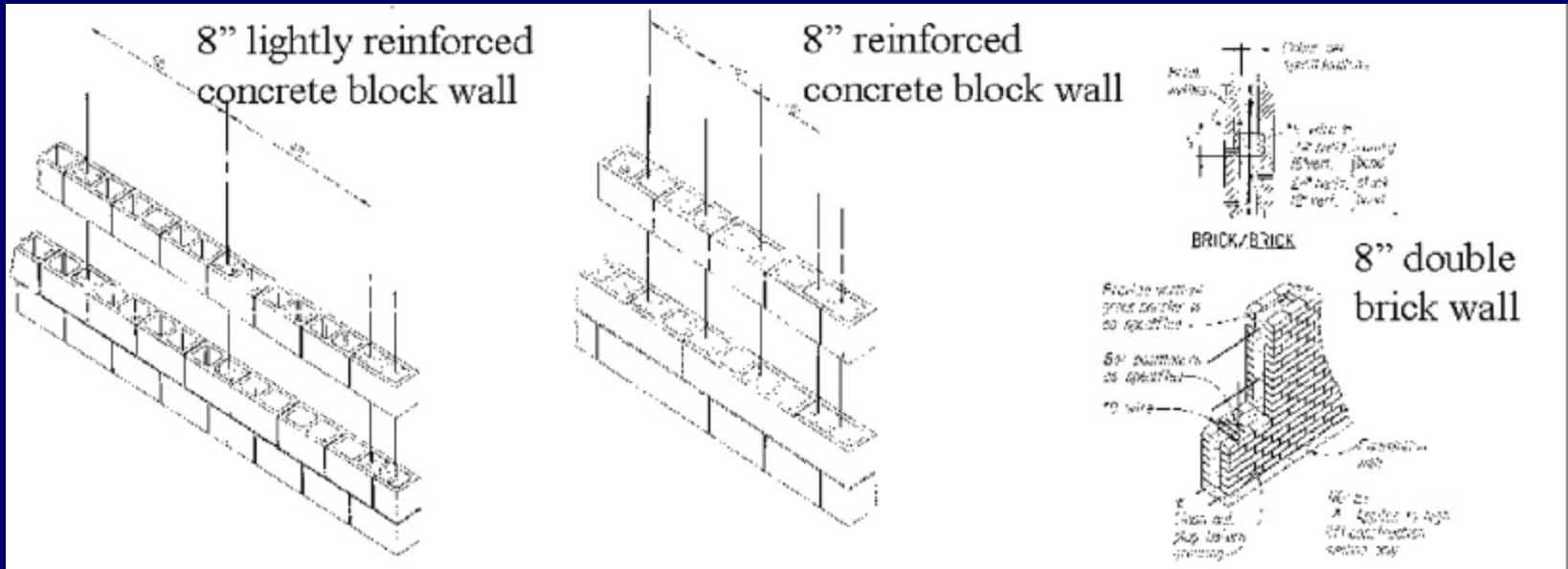


Concrete and Masonry Target Requirements

- Create a $>8''$ dia. opening
 - 8'' double brick wall
 - 8'' reinforced concrete block wall
- Reduce load bearing capacity (remove 75% of concrete)
 - 24'' reinforced concrete column
- Create entry hole ($> 39.3''$ or 1 meter dia. Hole)
 - 12'' triple brick wall
 - 8'' double reinforced concrete wall



8" Wall Targets Descriptions





8" Brick wall test results

3" Warhead

6" Warhead



- 6-inch warhead defeat target 12" x 13" through hole
- Other tests conducted
 - 327.5 ft. (100 m) standoff (13" X 15" through hole)
 - 60° Impact angle (15" X 16.5" through hole)



8" Concrete block wall test results



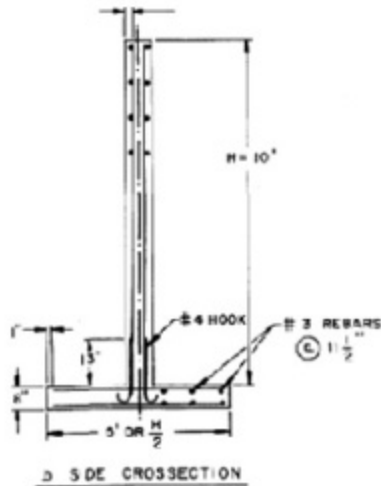
- 6-inch warhead defeat target
 - Aimed between rebars: 16" x 14" clear hole
 - Aimed at rebar: 19" x 17" clear hole
- Other tests conducted
 - 327.5 ft. (100 m) standoff (15.5" X 16" clear hole)
 - 60° Impact angle (18" X 16" clear hole)



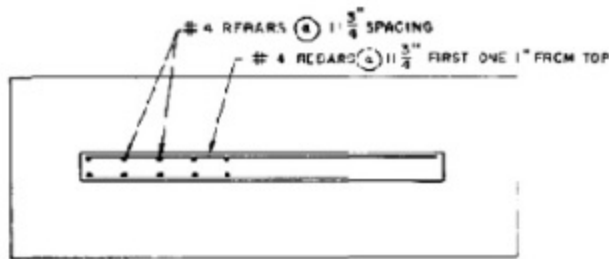
8" Reinforced Concrete Wall and 12" Triple Brick Wall

8" Double reinforced
concrete wall

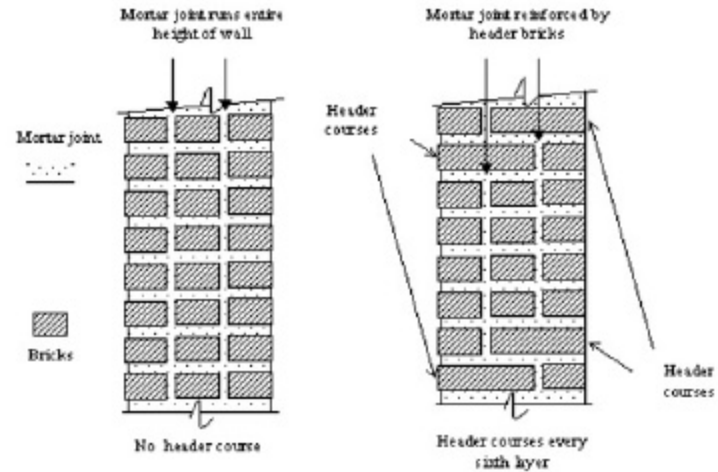
12" Triple brick wall



b SIDE CROSS SECTION



c TOP VIEW





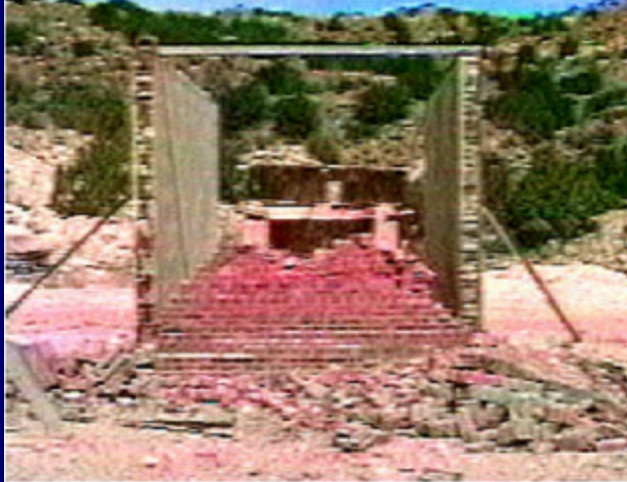
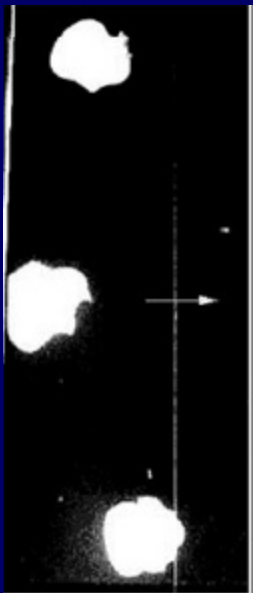
Approach to creating a 1 meter diameter opening



- Use an array of three warheads

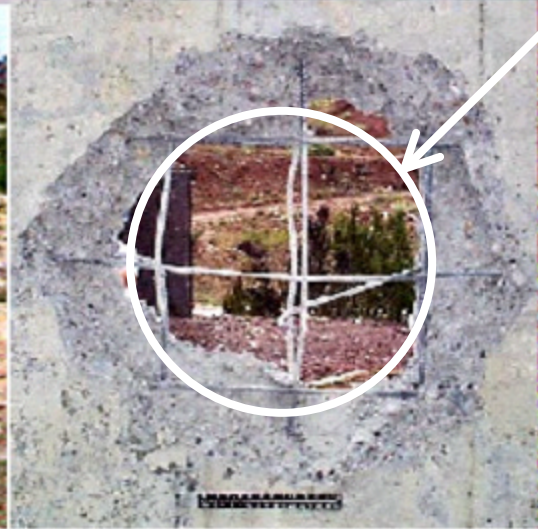
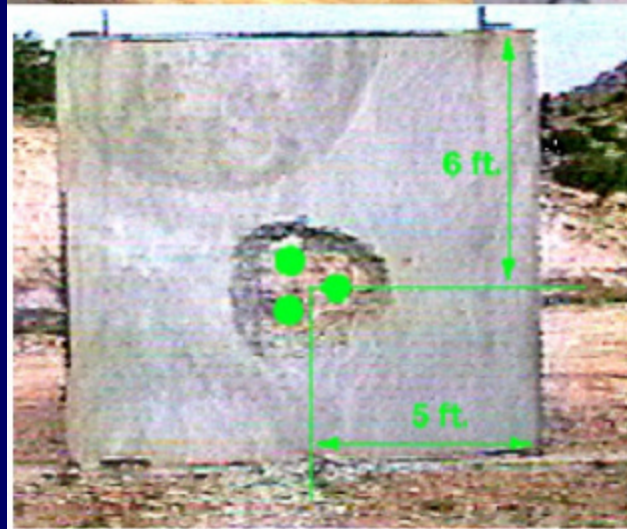
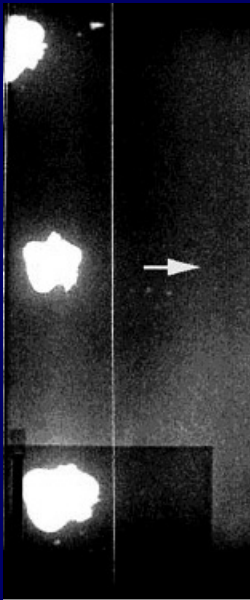


6-inch warhead array test results (12-inch Brick wall)





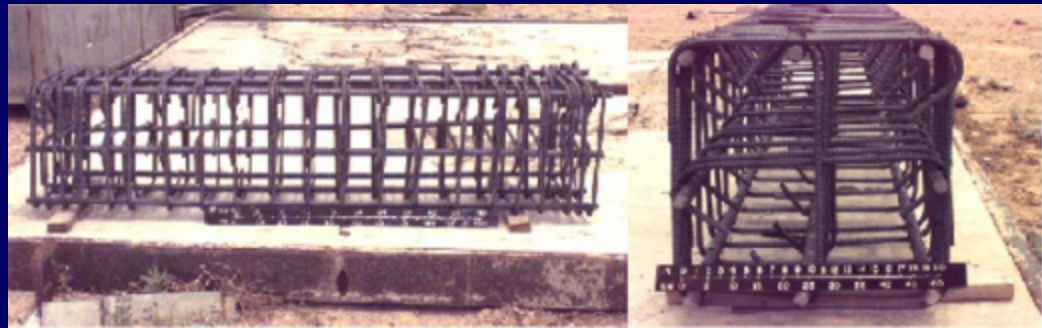
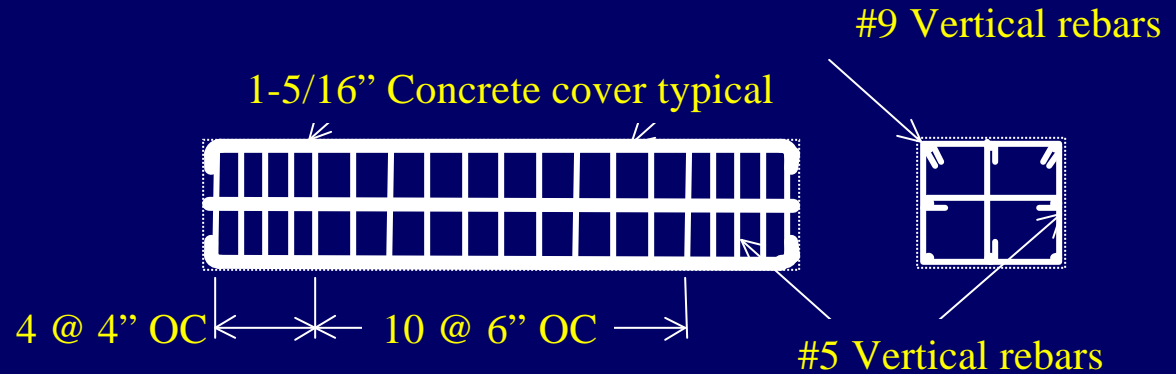
6-inch warhead array (8" reinforced concrete wall)



Ø29-inch



24" Concrete Columns



Concrete:

9 ksi (5 ksi min)

Cure time:

>45 days

Defeat criteria:

remove 75 % of concrete



EFP Warheads vs. 24-inch Reinforced Concrete Columns Video



One 8-inch warhead test



Two 6-inch warhead test



8-inch warhead test summary vs. 24-inch reinforced concrete column

Test 1
Ambient

Test 2
Ambient

Test 3
Cold

Test 4
Cold

Test 5
Hot

Test 6
Hot



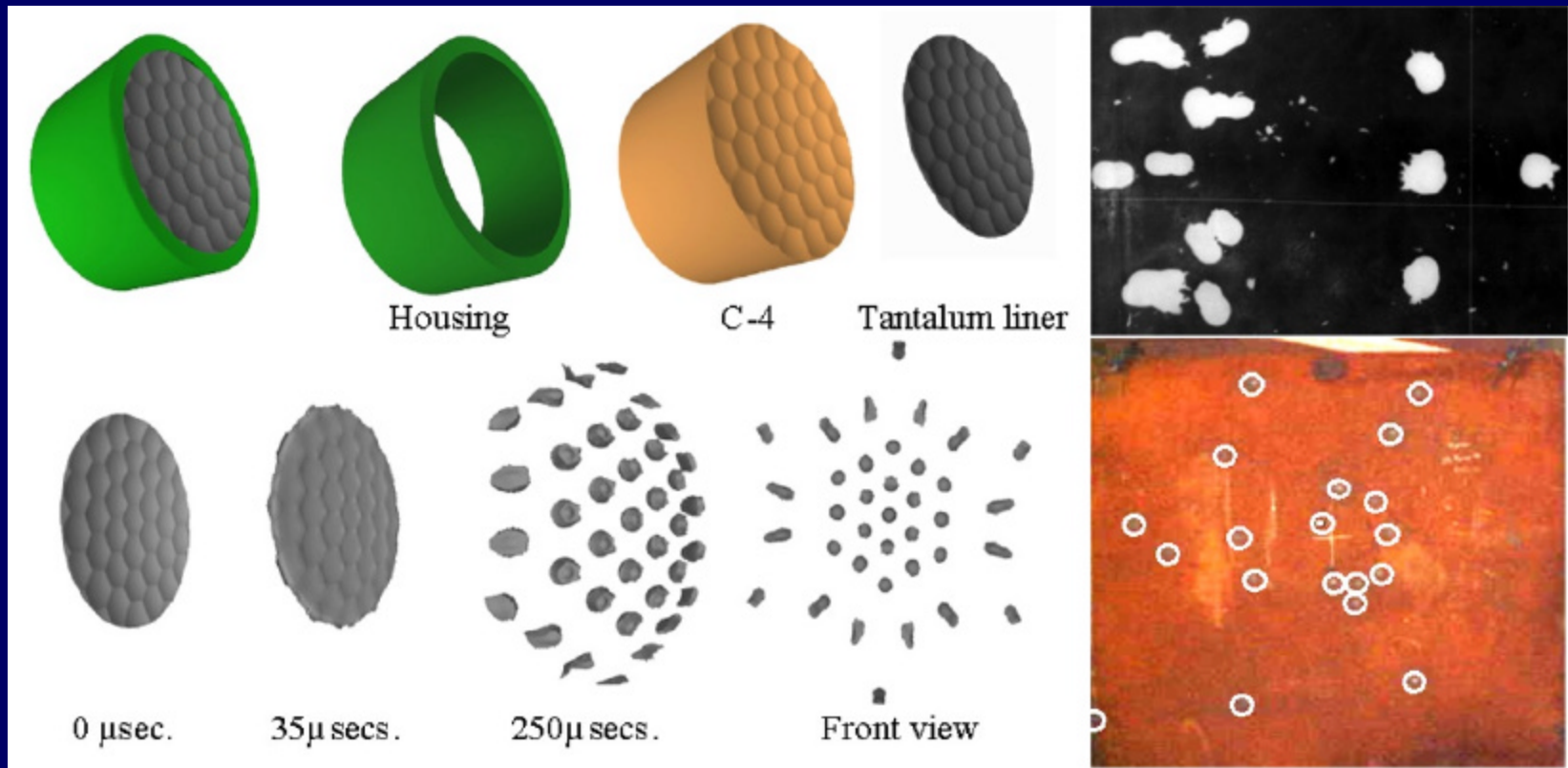


Other Warhead Designs

- Multiple EFP Warhead
 - Fire start capability
 - Mine neutralization
- Fence Piercing Warhead
- Extended Range Warhead (PAX-2a explosives)

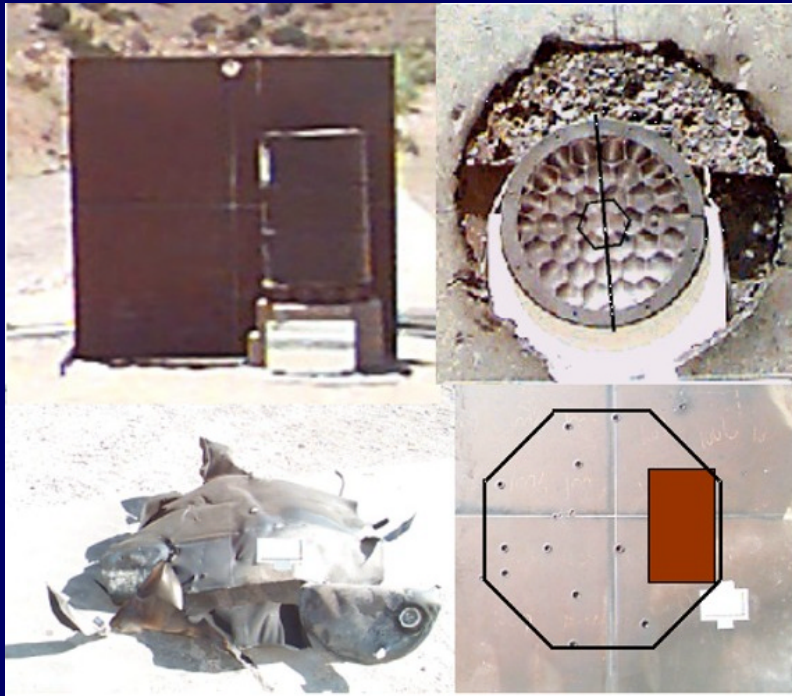


Multiple EFP Warhead



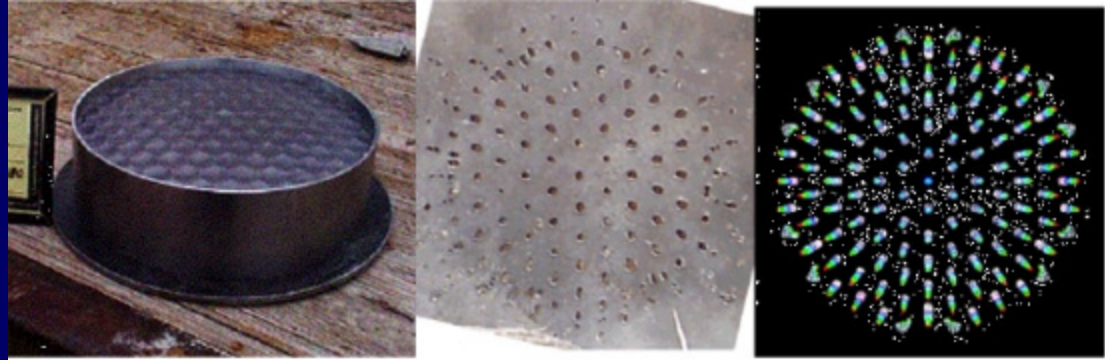


MEFP Warheads vs. Diesel Fuel Drum Video





MEFP Warhead for Mine Neutralization



MEFP Warhead to neutralize buried mine, demonstrated:

- MEFP warhead design that produced a 3.3' (1 meter) diameter coverage area
- Neutralized mines buried under 3"-8" of soil, sand and loose gravel



EFP Warheads vs. Targets protected by Fencing

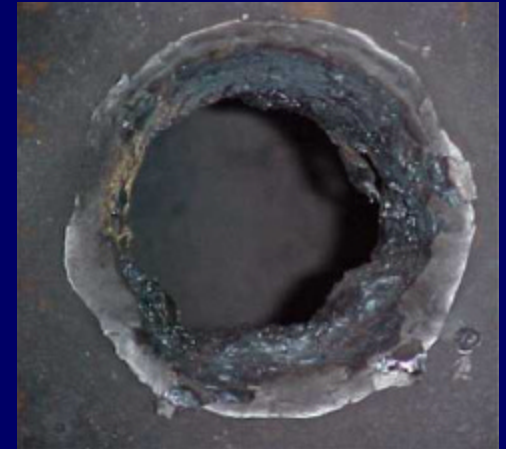


Test Setup

Fence at 30 & 40 ft.

Yaw Screen at 35 & 45 ft.

2.5" Armor at 50 ft.



Target defeated





SDK Warhead with PAX-2a

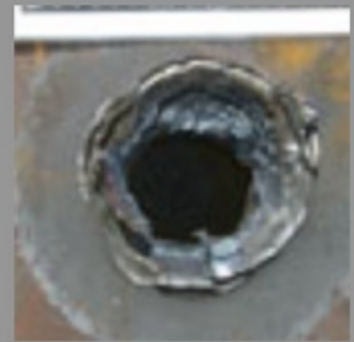
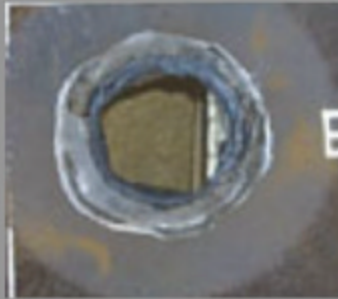
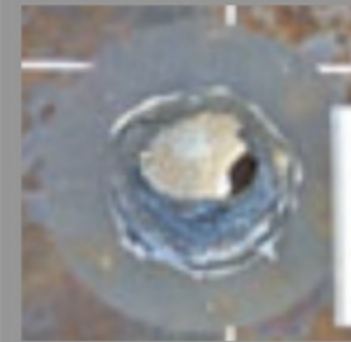
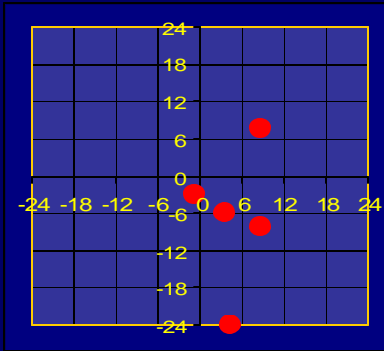
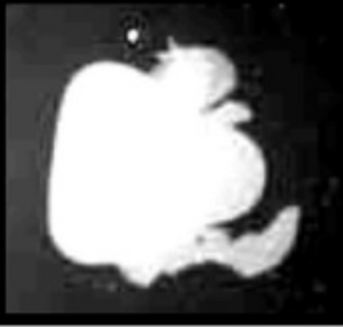
(327.5 ft. Or 100m. Against 2.5" RHA)

Cold

Cold

Hot

Hot



Target Holes

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Summary

- EFP Technology can be used for long standoff demolition warheads
- Demonstrated a family of EFP warheads for defeat of
 - Armored targets
 - Concrete block walls
 - Double and Triple brick walls
 - Reinforced concrete block walls
 - Reinforced concrete columns
- Other warhead designs being developed to
 - Defeat other SOF targets
 - Increase warhead effective range (25-100% increase)



Acknowledgements

- George Lutz – Office of the Project Manager for Close Combat Systems
- Vincent Alessio, Edward Chin, Richard Fong & Lamar Thompson - Warhead Group, U.S. Army TACOM-ARDEC