Long Standoff Demolition Warheads for Armor, Masonry and Concrete Targets

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Briefer: William Ng
U.S. Army TACOM-ARDEC
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

Housing: Glass filled Polyurethane
Explosive: Composition C-4
EFP Liner: Iron

Handpacked C-4

3D simulation of EFP formation
## EFP Warheads

<table>
<thead>
<tr>
<th>Warhead Dia. (in.)</th>
<th>Weight (lbs.)</th>
<th>C-4 (lbs.)</th>
<th>Hi-speed photo</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>0.35</td>
<td>0.2</td>
<td><img src="image1" alt="Small Warhead" /></td>
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<tr>
<td>3</td>
<td>1.14</td>
<td>0.6</td>
<td><img src="image2" alt="Small Warhead" /></td>
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<td>4</td>
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<td>1.4</td>
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<td>6</td>
<td>9.5</td>
<td>5.4</td>
<td><img src="image4" alt="Medium Warhead" /></td>
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<td>7</td>
<td>15.1</td>
<td>8.5</td>
<td><img src="image5" alt="Medium Warhead" /></td>
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<tr>
<td>8</td>
<td>19.2</td>
<td>11.2</td>
<td><img src="image6" alt="X-Large Warhead" /></td>
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<tr>
<td>12</td>
<td>83.2</td>
<td>47.6</td>
<td><img src="image7" alt="X-Large Warhead" /></td>
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</tbody>
</table>

Material eroded during recovery

EFP recovered
### Medium SDK EFP Warhead Data

<table>
<thead>
<tr>
<th>Shot</th>
<th>Range (ft.)</th>
<th>No. of tests</th>
<th>Avg. radial miss distance (in.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shot 1</td>
<td>50</td>
<td>17</td>
<td>2.7</td>
</tr>
<tr>
<td>Shot 2</td>
<td>163</td>
<td>3</td>
<td>14.6</td>
</tr>
<tr>
<td>Shot 3</td>
<td>196.5*</td>
<td>2</td>
<td>6.3</td>
</tr>
<tr>
<td>Shot 4</td>
<td>229</td>
<td>3</td>
<td>10.7</td>
</tr>
<tr>
<td>Shot 5</td>
<td>327</td>
<td>5</td>
<td>16.8</td>
</tr>
<tr>
<td>Shot 6</td>
<td>491</td>
<td>1</td>
<td>9.1</td>
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</table>

*50 meters

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Armor penetration data at 50 ft.

Penetration (in.)

Charge Diameter (in.)
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 concrete wall
8” Wall Targets Descriptions

8” lightly reinforced concrete block wall

8” reinforced concrete block wall

8” double brick wall
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
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)
24” Concrete Columns

Concrete: 9 ksi (5 ksi min)
Cure time: >45 days
Defeat criteria: remove 75 % of concrete

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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

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Other Warhead Designs

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

Housing  C-4  Tantalum liner

0 µsec.  35 µsecs.  250 µsecs.  Front view

Target Photo @ 75 m (245 ft.)
19 Perforations

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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
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

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