REPLACEMENT OF OCTOL WITH IM EXPLOSIVE IN SMAW HEAA WARHEAD


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Indian Head, MD
Presentation Outline

• Objectives
• Approach
• System Description
• Explosive Selection
• Qualification and Performance Tests
• Summary
• Acknowledgements
Objectives

• Replace SMAW HEAA warhead fill (Octol) with explosive of comparable performance and improved IM characteristics
  – Sponsor directive: only system change will be explosive fill

• Meet current HEAA penetration requirements

• Qualify SMAW HEAA with IM warhead fill (SMAW HEAA-IM Warhead)
Approach

• **Phase I: Explosive Selection**
  – Explosive Selection Committee
  – IM and Performance Testing in SMAW HEAA Warhead
  – Downselection to Final Explosive Fill

• **Phase II: Qualification and Performance Testing SMAW HEAA-IM Warhead**
SMAW HEAA System Description

- Shoulder-launched Multi-purpose Assault Weapon High Explosive Anti-Armor
- DODIC HX06
- Effective against medium armor
- SMAW HEAA consists of:
  - MK 153 MOD 0 Launcher
  - SMAW HEAA Encased Assault Rocket (EAR)
- SMAW HEAA Rocket consists of:
  - Rocket motor
  - Impact fuze
  - Shaped charge, high explosive warhead
Selection of IM Explosive Candidates
Explosives Assessment

- Explosive Output
- IM Survivability
- Safety & Reliability
- Producibility / Life Cycle Costs
Explosive Candidates

- PBXN-9
  - Used in Navy & Army shaped charge ordnance
  - Good IM in FCO/SCO/BI
  - Bad IM in FI

- PBXN-11
  - Better performance than PBXN-9
  - Good IM in FCO/SCO
  - Bad IM in BI/Fl

- PBXW-114
  - Equivalent performance to PBXN-110
  - Good IM in FCO/SCO/BI
  - Potential for significant improvement in FI
# Explosive Properties

<table>
<thead>
<tr>
<th>Explosive</th>
<th>Composition</th>
<th>Manufacture Method</th>
<th>Density, g/cc</th>
<th>FCO/SCO/BI</th>
</tr>
</thead>
<tbody>
<tr>
<td>PBXN-9</td>
<td>HMX/binder</td>
<td>pressed</td>
<td>1.73</td>
<td>V/V/V</td>
</tr>
<tr>
<td>PBXN-11</td>
<td>HMX/binder</td>
<td>pressed</td>
<td>1.80</td>
<td>V/V/IV</td>
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<tr>
<td>PBXW-114</td>
<td>HMX/Al/binder</td>
<td>cast</td>
<td>1.71</td>
<td>V/V/V</td>
</tr>
<tr>
<td>Octol</td>
<td>HMX/TNT</td>
<td>melt (sedimentation)</td>
<td>1.82</td>
<td>I/I/V</td>
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</tbody>
</table>
Phase I. IM and Performance Tests
Phase I Testing

- **Slow Cook-Off**
  - 2 rockets with live warhead assemblies and inert rocket motor and fuze, of each explosive fill plus Octol baseline
  - Tests performed at Dahlgren Division, NSWC

- **Fragmentation Impact**
  - 2 rockets with live warhead assemblies and inert rocket motor and fuze, of each explosive fill plus Octol baseline
  - Tests performed at Dahlgren Division, NSWC

- **Penetration**
  - 3 warheads of each explosive fill (2 for PBXN-11) plus Octol baseline
  - Tests performed at Dahlgren Division, NSWC

- **Flash X-ray**
  - 2 warheads of PBXN-9 and PBXW-114 fills plus Octol baseline
  - No PBXN-11 loaded warheads available
  - Tests performed at ARL, Aberdeen, MD
PBXN-11 Loading

- Problems encountered loading PBXN-11 charges
- PBXN-11 tended to adhere to case wall when pressed under conditions used for PBXN-9 charges and caused case deformation
- PBXN-11 charges for tests were pressed as free-standing billets, slipped into warhead case, and then pressed lightly
- Loading process improvement required if PBXN-11 selected
# Summary of Phase I Results

<table>
<thead>
<tr>
<th>Explosive</th>
<th>Density</th>
<th>Current Processibility</th>
<th>Penetration</th>
<th>IM Reactions</th>
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<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>SCO</td>
<td><strong>Frag Impact</strong> (T1 8300 ft/sec, T2 6000 ft/sec)</td>
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<tr>
<td>PBXN-9</td>
<td>1.744</td>
<td>Yes</td>
<td>passed</td>
<td>(IV)** (2) Deflagration I (2) Detonation</td>
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<tr>
<td></td>
<td>1.744</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>1.750</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PBXN-11</td>
<td>1.769 *</td>
<td>No</td>
<td>passed</td>
<td>(V)** (2) Burn I (2) Detonation</td>
</tr>
<tr>
<td></td>
<td>1.803</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PBXW-114</td>
<td>~1.71</td>
<td>Yes</td>
<td>failed</td>
<td>(IV)** (2) Deflagration I (1) Detonation</td>
</tr>
<tr>
<td>Octol</td>
<td>1.80-1.85</td>
<td>N/A</td>
<td>baseline</td>
<td>I (2) Detonation I (2) Detonation</td>
</tr>
</tbody>
</table>

* 98% TMD is 1.793 gm/cc. 1.769 is 96.7% TMD
**Not officially scored; engineering judgement of test results
IM Explosive Selection

- PBXN-9 Selected
- Based on
  - Performed well in penetration tests
  - IM characteristics
  - Fielded as main charge in other shaped charge warheads
  - Drop in solution
- Place barrier tape between PBXN-5 booster and PBXN-9 explosive
- Informally refer to SMAW HEAA system with PBXN-9 warhead fill as “SMAW HEAA-IM Warhead”
Phase II. Qualification and Performance Tests for SMAW HEAA-IM Warhead
Qualification and Performance Tests

- Objectives
  - Ensure that SMAW HEAA-IM Warhead meets IM and Hazard Classification (HC) requirements
  - Obtain Final (Type) Qualification of the SMAW HEAA-IM Warhead
  - Verify that replacement of warhead fill has not caused degradation of system performance
Phase II Tests

• Test Items
  – Built by Nammo Talley, Inc.
  – Warheads loaded by IHDIV, NSWC
  – Liners are Government Furnished Material (GFM)
  – Mk 259 Fuzes are GFM

• Testing will be conducted by National Technical Systems (NTS), Camden, Arkansas during March – June 2009
Qualification Tests

Tests harmonized for IM and HC Purposes, but include only a limited subset of HC and FTQ tests, since this effort is only changing the warhead explosive fill and not safety features of the system

- Basic Safety Tests w/ Thermal Stability
- Sympathetic Detonation (Stack Test)
- Fast Cook-Off
- Slow Cook-Off
- Bullet Impact
- Fragment Impact
Basic Safety Tests w/ Thermal Stability
Sympathetic Detonation

- IAW MIL-STD-2105C and STANAG 4396
- Both unconfined and confined stack tests
- Variously configured rounds in each test
- Expected results: Passing reaction
Fast Cook Off

- IAW MIL-STD-2105C, STANAG 4240, & NAVSEAINST 8020. B
- Two FCO Tests
  - (1) test with 6 All-Up Rounds in shipping container
    - Expected result: Type I Detonation
  - (1) test with single, bare EAR with live warhead assembly and spotting cartridge, and inert rocket motor and fuze
    - Expected result: Type V Burn
Slow Cook Off

• IAW MIL-STD-2105C and STANAG 4382
• (2) tests conducted on bare EARs containing live warhead assemblies and inert rocket motors, fuzes and spotting cartridges
• Expected result: Type IV Deflagration at warhead level
Bullet Impact

- IAW MIL-STD-2105C and STANAG 4241
- (2) tests on bare EARs containing live warhead assemblies and inert rocket motors, fuzes, and spotting cartridges
- Expected result: Type V Burn at warhead level
Fragment Impact

- IAW MIL-STD-2105C and STANAG 4496
- (2) tests on bare EARs with live warhead assemblies and inert rocket motors, fuzes, and spotting cartridges
- Expected result: Type I Detonation
Performance Testing

• Flight performance testing on All-Up Rounds at hot, cold, and ambient temperatures
• Static penetration testing on warhead-only assemblies against RHA
• Accelerated aging and vibration profiling sequence, followed by static penetration, on warhead-only assemblies
• Flight performance and penetration testing conducted IAW Weapon Specification
Summary

- PBXN-9 selected as IM explosive for SMAW HEAA warhead
- Qualification test plan received concurrence from WSESRB and Hazard Classification offices
- Warheads have been loaded
- Test items have been built
- Qualification and performance testing is underway
Acknowledgments

• Sponsor: Marine Corps Systems Command Program Manager for Ammunition (PM Ammo)
  – Program Manager: Richard Dooley
  – Project Engineer: Richard Hardy
  – Technical Advisor: Tim Portner, Dahlgren Division, NSWC

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