Development of 155mm M795 IM Precision Guidance Kit (PGK) Compatible Projectile

TECHNOLOGY DRIVEN. WARFIGHTER FOCUSED.

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Background

• The Army Qualified IMX-101 as the main fill for the 155mm M795 Artillery Projectile in June 2010

• The Army is now moving towards guided fuzes, ie Precision Guidance Kit (PGK), which is a deep intrusion fuze.
  – Due to the supplementary charge being removed for PGK use, IMX-101 would not be compliant with this fuze
Legacy D529

- Army developed projectile
- Contains 24lbs of HE
- Consists TNT supplemental charge
- Poor IM testing results

Changes via Army ECP (a)

DA54 Non-PGK Fuze Compatible

- Replaces TNT with IMX-101
- Consists PBXN-9 supplemental charge
- Less sensitive than legacy D529
- Not compatible with PGK fuze
- Currently not in inventory and no plans to field

Changes via Army ECP (b)

DA54 PGK Fuze Compatible

- Similar to DA54 non-PGK fuze compatible, uses IMX-101 and PBXN-9 as supplemental charge
- Contains IMX-104 transfer charge to accommodate PGK fuze compatibility
- Maintains same IM performance as DA54 non-PGK fuze compatible projectile
M795 IM PGK Fuze Compatible Round

- PBXN-9 Supplementary Charge (Removed for PGK)
- Felt Pad (Removed for PGK)
- Plastic Liner
- IMX-104 Transfer Charge
- M795 Artillery Shell
- IMX-101 Main Fill
- PBXN-5 PGK Booster
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Testing Completed per ITOP: 4-2-504(1) Safety Testing of Field Artillery Ammunition
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<td>DA54 PGK Fuze Compatible</td>
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<td>Successful</td>
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<td>Long Term Storage</td>
<td>DA54 PGK Fuze Compatible</td>
<td>No Results at This Time (Started October 2012)</td>
</tr>
<tr>
<td>Explosive Ordnance Disposal (EOD)</td>
<td>DA54 PGK Fuze Compatible</td>
<td>Good data to select an effective EOD procedure</td>
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<tr>
<td>Irreversible Growth Test</td>
<td>DA54 PGK Fuze Compatible</td>
<td>Minimal Changes</td>
</tr>
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<td>Adverse Environments – included in SET</td>
<td>DA54 PGK Fuze Compatible</td>
<td>Successful</td>
</tr>
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<td>Pallet Packaging Test – included in SET (Vibration Tests)</td>
<td>DA54 PGK Fuze Compatible</td>
<td>Successful</td>
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</table>

No Safety Anomalies Reported on DA54 PGK Fuze Compatible Projectile
### Harmonized HC/IM

<table>
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<th>Hazard Classification</th>
<th>IM</th>
<th>Results</th>
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<td>UN Test 6 (C) Liquid Fuel/External Fire</td>
<td>Fast Cook-off*</td>
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<td>Slow Heating</td>
<td>Slow Cook-off</td>
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<td>Fragment Impact</td>
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<td>UN Test 6(b) Sympathetic Reaction</td>
<td>Sympathetic Reaction*</td>
<td>Pass</td>
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<td>Shaped Charge Jet</td>
<td>Shaped Charge Jet*</td>
<td>Pass</td>
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<tr>
<td>UN Test 4(a) Thermal Stability</td>
<td>Hazards Classification Testing</td>
<td>Pass</td>
</tr>
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<td>UN Test 4 (b) (ii) 40ft Drop</td>
<td>Hazards Classification Testing</td>
<td>Pass</td>
</tr>
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</table>

*AIMB accepted previous test scores via engineering assessments (previously tested with DA54 Non-PGK Fuze Compatible)
Bullet Impact with PBXN-9 Supp Charge
Aim Point Test Setup
Bullet Impact Test 1 - PBXN-9 SC Results

• Three 0.50 caliber AP bullets into the SC @ 2749.8, 2762.4 and 2739.7 ft/sec
• First bullet caused a piece of the test unit to break off expelling the lifting plug.
• The second bullet still impacted the aim point.
• The third bullet missed the target due to it being knocked off.
• The farthest fragment recovered was a lifting plug at 39.75’
• Type V reaction. 0 PSI recorded on all gauges.
Bullet Impact Test 2 - PBXN-9 SC Results

• Three 0.50 caliber AP bullets into the SC @ 2744.7, 2851.7, and 2780.4 ft/sec
• The first bullet caused the lifting plug to expel.
• The second bullet still impacted the aim point.
• The third bullet missed the target due to it being knocked off.
• The farthest fragment recovered was a lifting plug at 67.58’.
• Type IV reaction. 0 PSI recorded at all gauges.
18.6gm conical fragment fired @ 8186.2 ft/sec into the SC
Upon impact there was a large fireball and the test article was knocked off of the stand.
Large pieces of shell casing were found around the test range.
Pieces of unreacted HE found from 0° to 300° out to 5.17’
The farthest fragment recovered was a piece of projectile case found at 145.83’
Peak pressure of 0.5 PSI was recorded at 20’ distance from the test item.
Type IV reaction.

Fragment Impact 1 - PBXN-9 SC Results
Fragment Impact 2 - PBXN-9 SC Results

• 18.6gm conical fragment fired @ 8415.3 ft/sec into the SC
• Upon impact there was a large fireball and the test article was knocked off of the stand.
• Large pieces of shell casing were found around the test range.
• Pieces of unreacted HE found from 0° to 360° out to 45’
• The farthest fragment recovered was a piece of lifting plug found at 169.58’
• Peak pressure of 0.4 PSI was recorded at 20’ distance from the test item.
• Type IV reaction.
Slow Cook Off – Test Set Up
Slow Cook-off – Test 1 Results
Slow Cook-off – Test 2 Results

Type V
UN Test 4(a) Thermal Stability Test*

• One test for evaluating thermal stability
  – One M795 round in oven at 167 ± 35.6°F for 48 hours
  – A thermocouple attached to the casing recording the temperature once per minute.
  – Passing criteria
    • No explosion
    • No ignition
    • No substance exudation
    • No temperature rise exceeding 37.4°F
    • No damage to the outside casing

* This test is for Hazard classification
Thermal Stability – Results

- The visual inspection revealed no anomalies - Pass

Thermocouple placement

Test Setup
40 ft Drop - Test Set Up

Base Down  Nose Down  Major axis Horizontal
40 Ft Drop – Results

- **Base Down**: Pass
- **Nose Down**: Pass
- **Major axis Horizontal**: Pass
Conclusions

• Changes were successfully made to M795 IM via Army ECP (DA54) to improve IM characteristics and for compatibility with PGK fuze use
  • These changes did not compromise the IM or Performance of this Artillery Round
• Future efforts will evaluate the use of a pressed transfer charge to reduce production costs
• M795 IM PGK Compatible Artillery Rounds will go into FY14 production schedule
QUESTIONS?

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