

Processing and Sensitivity Testing of the Insensitive TNT Based Explosive – PAX-44

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- **ATK Strategy for IM Replacement Energetics**
- **M795 Energetic Replacement Project**
- **PAX-44 – Basic Information**
- **Processing Experiments and Demonstrations**
 - LAP Study
 - Finishing Study
- **IM Experiments and Demonstrations**
 - BI Test series
 - Cook Off Testing
 - Sympathetic Detonation Testing
- **Conclusions**

- **Overarching Goal:**

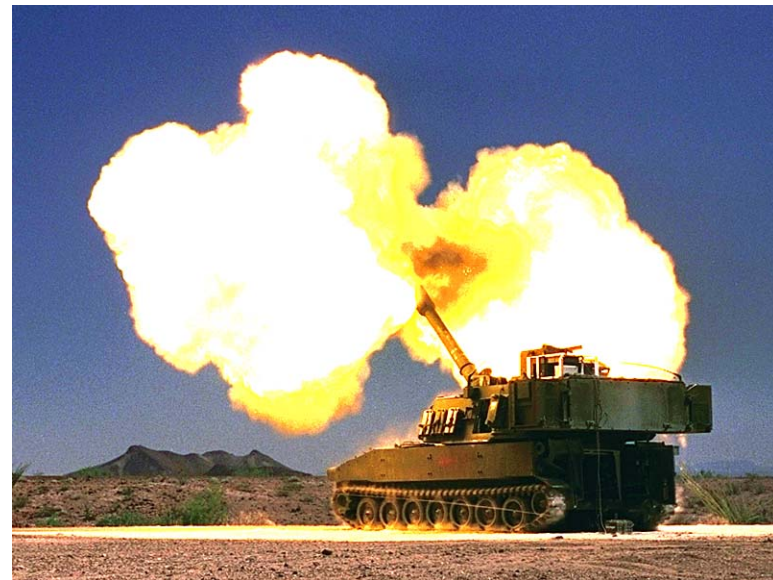
- Provide MIL-STD 2105C Compliant Energetic Solutions based on Low-Cost Proven Technologies to drive Low Life-Cycle Cost Growth and meet Warfighter Demands
- **Comply with system specific Threat Hazard Assessments with the target goals of full 2105C compliance**
- **Utilize proven basic technologies to minimize implementation upsets with a focused Design For Six Sigma driven approach**
- **Plan for Low Life-Cycle Cost Growth**
 - Break the standard cycle of high cost IM energetics
 - Provide cost effective solutions without passing the costs up the supply chain
 - Maximize fielding amounts of needed munitions on a fixed POM budget

M795 Energetic Replacement Project

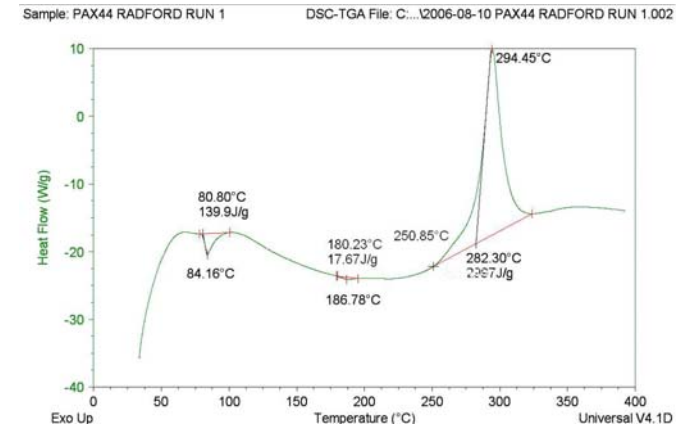
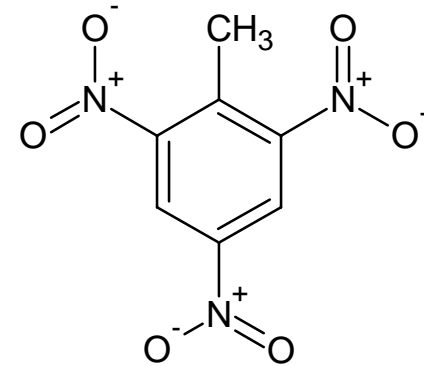


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- **IM Improvement for Legacy GP Artillery Rounds**
 - 155mm M795 HE used as test bed
 - Culmination of a multi-year multi source competition
 - ATK was a primary stakeholder as the provider of legacy energetics
- **Competitive test covered all aspects of supply chain and munitions life-cycle**
- **Testing was conducted as head-to-head sensitivity and performance testing with consideration for life-cycle cost impact**



- TNT Based IM energetic
- 80/20 TNT / Performance Desensitizing Additive (PDA)
- PDA was an engineered, oxygen carrying, density matched, organic fuel that serves as an inert additive to dilute threat stimuli but contributes near-equivalent energy in the detonation regime
- Formulation allows all the benefits of TNT
 - Easy melt casting
 - Flaking
 - Low-toxicity
 - Excellent storage characteristics
- PDA is designed to provides advantages to shock mitigation (BI, FI, SD, SCJ) and benefits to Cook-off thermal stability

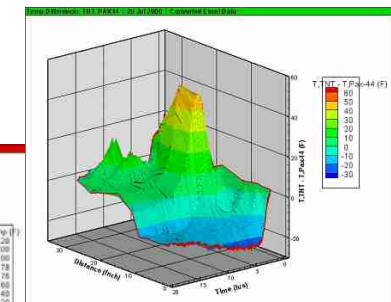
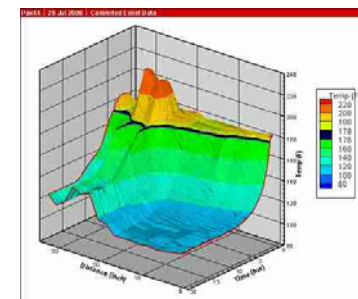


LAP Study



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- Iowa Army Ammunition Plant – Indirect Fire Business Unit
- Full Scale Pour of 45 Projectiles using production equipment
- Screening experiment to determine if x-ray acceptable rounds could be cast with PAX-44 using the current range of process controls (TNT -> Comp-B)
- Follow on testing to determine effect of feather and process additives
- Army ARDEC Bldg. 810 Process Optimization Experiments
- Belt Flaking PAX-44 for feather material
- Optimized Model Based Controller cooling profiles
- On-site test articles for ARDEC IM testing



Pour Quality Progression



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Finishing Study



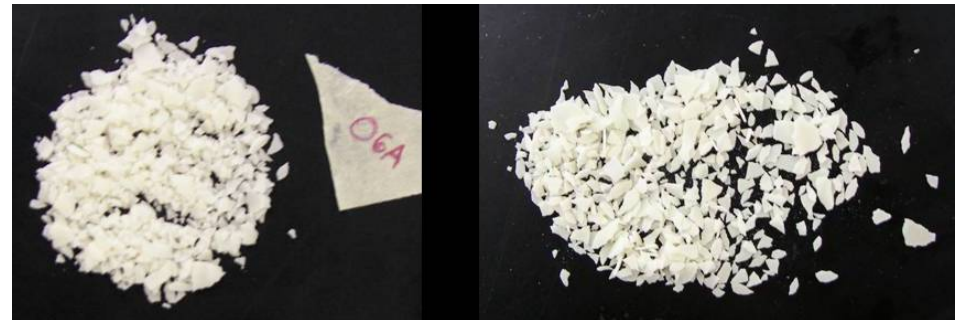
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- **ATK – Energetic Systems Division**
– **NTIB TNT Facility**

- Supplier of TNT for M795 LAP operations
- Only domestic manufacturer of TNT

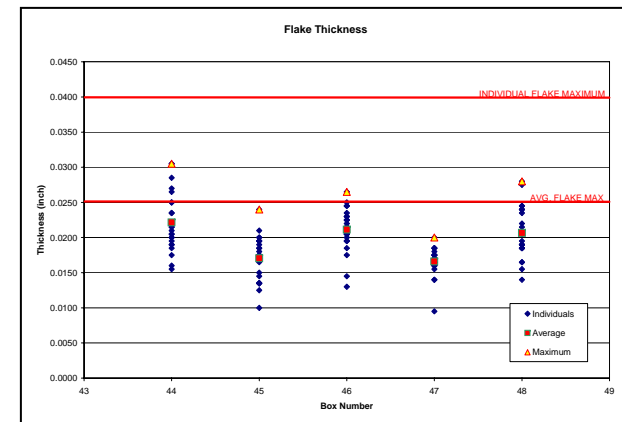
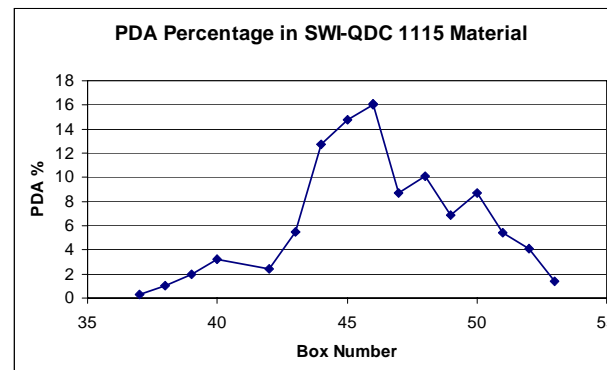
- GOAL

- Use standard finishing process and production equipment to make PAX-44 flakes conforming to the same military quality standard as Type I Flake TNT
- Demonstrate path for low impact facilitization of PAX-44 if needed to support major testing or classification operations



NTIB TNT – Jan 2006

PAX-44 SWI-QDC 1115



- **IM Experimentation and Demonstrations**
- Bullet Impact Testing
 - 9 PAX-44 tests (NTS-Camden, ATK-LS, ARDEC)
- Cook-off Testing
 - Fast Cook-off (NTS-Camden)
- Sympathetic Detonation Testing
 - Duplicate testing (NTS-Camden)

PAX- 44 BI Testing – Phase 1



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- **Initial Testing Conducted with Projectiles from first casting at IAAAP**
- (2) Tests – STANAG 4241
- Repeated Type III Reaction
- Sensitivity linked to cast quality



PAX- 44 BI Testing – Phase 2



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- Efforts to improve casting quality (Feathering, Process Additives, MBC Cooling)
- Consistent Improvement of Bullet Impact Response over range of cast-qualities



Type III

Type IV



Type V

PAX- 44 BI Testing – “No Reactions”



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- Rounds with excellent cast quality repeatedly demonstrated “No Reaction” aka Type VI reaction to Bullet Impact Testing



Unresolved Issues in BI Testing



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- **Unfortunately, Cast quality is not the only driver of Bullet Impact Response**
- 3 Tests (above) all conducted using X-Ray Approved munitions
 - Passed MIL-P 63252 rev A and MIL-STD 453 Criteria for TNT loaded projectiles
- Reactions ranged from Type III Explosion to “No Reaction”
- As yet an unresolved issue

Cook Off Testing



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- Energetic and System level Improvements to M795 Cook Off response showed incremental improvement, but did not meet program goals

- Why is cook off so tough?

- Logistical Configuration
 - Large Explosive/Case mass ratio
 - Vertical Orientation
- Energetic Issues
 - Foaming TNT provides infinite path flame front
 - Work underway to provide additional Cook-off Response mitigation



Sympathetic Detonation Testing



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- Initial indications showed that shock propagation was likely at expected separation distances
- Testing conducted for information purposes and to provide baseline data for improvement projects



•PAX-44 has demonstrated capabilities

- Processing
 - High TNT percentage allows it to be processed in a manner consistent with TNT and Comp-B
 - Relative low additive percentage allows it to be drum-flaked and meet TNT spec for flake character
 - Builds on TNT strengths of long-term stability and low chemical reactivity
- Sensitivity
 - IM testing of PAX-44 loaded munitions show improved response to impact based testing
 - PAX-44 shows incremental improvement with respect to SD testing and Cook Off
- Cost
 - Using proven low-cost materials the cost impact to making an energetic fill less sensitive can be minimized

