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Demonstration of Insensitive Common Explosives (ICE)

Prepared For

**NDIA 41st Annual Armament Systems:
Gun and Missile Systems Conference & Exhibition
Sacramento, California
March 27-30, 2006**

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There are several problems with current IM compounds , such as:

- **High cost**
- **Additional production steps for melt-pour facilities**
- **Some IM compounds require extensive investment in existing facilities**
- **Multiple compounds needed to produce limited IM results**
- **Toxicity concerns for personnel and waste management**
- **Life-cycle analyses are limited**
- **Lethality degradation**
- **Sensitivity concerns**
- **Balance between impact and thermal threats**
- **Currently, there are unique solutions for different munitions**

There Exists A Need For A Common, Low-Cost IM Solution For Bomb And Artillery Fills!

ATK NTIB TNT Flexible Energetics Facility



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US Government awarded ATK a contract to produce TNT

ATK NTIB TNT facility designed and built as a flexible energetics facility and offers a more environmentally friendly process

- Currently producing TNT and can produce other flexible energetics such as Dinitroanisole (DNAN), TEX, NTO and CL-20
 - >100,000 lbs made during startup
- 5-15 million pound annual TNT capacity
- Continuous operation requires changeover planning
- Current process produces no red/yellow water and offers a significant reduction in emissions/waste stream
- Fewer impurities (no or significantly reduced exudation); purity is 99.99% 2,4,6-TNT



**NTIB Facility At RAAP Is
A Flexible Energetics Plant**

Why TNT-Based Insensitive Common Explosives?



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- TNT is the historic common explosive.
- TNT processing is well understood.
- TNT already has low impact sensitivity and good thermal sensitivity.
- TNT is low cost.
- Manufacturing and loading infrastructure is already in place.
- TNT offers tailorable performance (Comp B, Tritonal, Octol, etc.)
- Formulation only needs to be less sensitive than TNT at same or improved performance.



Insensitive Common Explosive (ICE)

There is a Reason Why TNT Has Been The Explosive of Choice for 100 Years.

What Is I-TNT (PAX-44)?



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- **I-TNT is a reduced sensitivity TNT-based formulation**
 - I-TNT formulation is simple (I-TNT = TNT + Additive)
 - Additive is low cost, readily available and environmentally friendly
- **I-TNT (PAX-44) is a “drop in” to the NTIB TNT manufacturing and loading operations**
 - I-TNT takes advantage of the low-cost NTIB TNT production line and provides a range of flexible alternatives for performance
 - Minimal modifications to manufacturing and melt/pour facilities will be required for optimization

**I-TNT (PAX-44) Formulation is Being Developed
for 155mm HE Projectiles**

- **Additives screened for IM characteristics**
- **Mixes made and testing completed for down select**
 - Thermal compatibility, Vapor Pressure, Efflux Viscosity, Shrinkage, Toxicity, Solidification Properties and Hazards Sensitivity (friction, impact, ESD, etc.)
- **Sub-scale testing completed**
 - Bullet Impact, Slow Cook-Off, Shape Charge Jet
- **Mid-Tier testing completed**
 - Used 4" long, 155mm enclosed sections
- **Cheetah[®] Performance Prediction completed and verified with Dent and Rate**
- **Full-scale testing initiated**
 - Currently awaiting process changes to improve cast quality

**I-TNT Program Has Made Rapid Progress Due To
Ease Of Formulation Development**

I-TNT Sub-scale Test Results Compared to TNT



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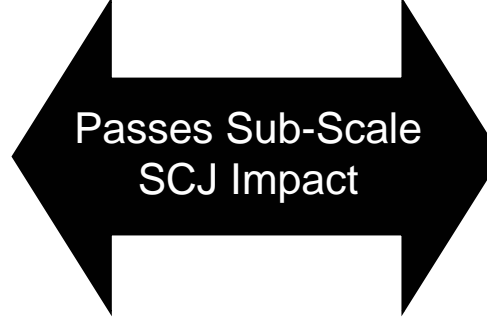
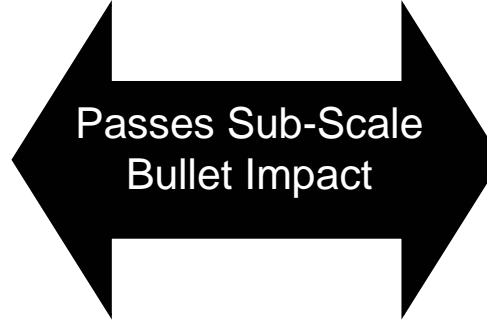
TNT

Dent and Rate Data
0.32 in (85 RB): 6.64 km/s



I-TNT

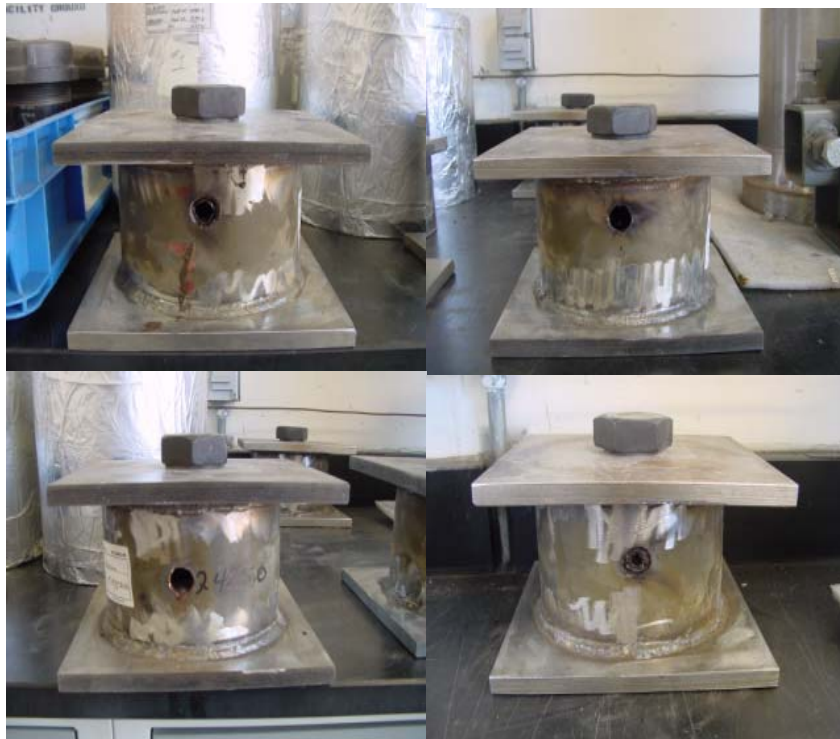
Dent and Rate Data
0.325 in (83 RB): 6.51 km/s



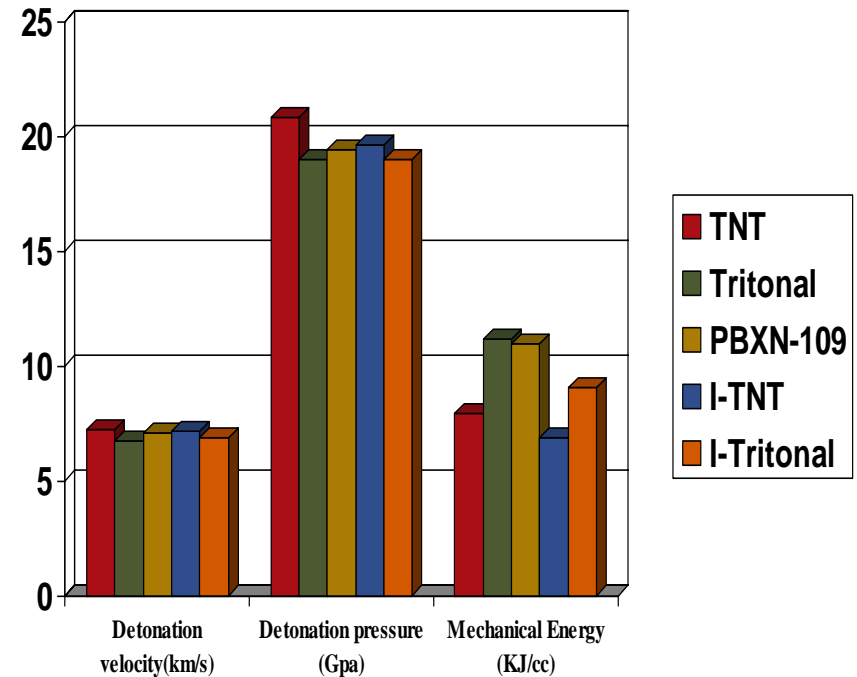
I-TNT Mid-Tier Test Results



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I-TNT demonstrated No Reaction in four Bullet Impact tests using 4" long 155mm case sections.



Cheetah[®] modeling predictions for I-TNT compared to other explosives.

**I-TNT Demonstrated Reduced Sensitivity
And Matched TNT Performance**

- **Optimize melt/pour process to fill 155mm M795 rounds**
 - **Feedback from melt/pour facility has been positive for small-scale pours:**
 - *“I-TNT shows great promise.”*
 - *“I-TNT is compatible with our current process.”*
 - **Transition “lessons learned” during small-scale pours to a full-scale pour at IOWA Army Ammunition Plant**
- **Conduct full-scale 155mm testing**
 - **Full series of IM tests + Arena tests for performance**
- **Related formulation development**
 - **Leverage I-TNT success for transition into bomb fill solution using same formulation**

**I-TNT Program Is Moving Forward For
Full-Scale 155mm Testing In 2006**

- **NTIB TNT facility at RAAP currently in initial production of TNT to meet current warfighter needs**
- **I-TNT utilizes current TNT production, melt/pour and LAP facilities with minimal infrastructure changes**
- **Tactical systems that use TNT will require minimal design changes when transitioning to I-TNT**
- **Tactical configuration (155mm M795) demonstrations will be completed this year**

Warfighter Requirements

Development

Production

I-TNT's Low-Cost IM Formulation Can Be Rapidly Transitioned To Production at NTIB TNT Facility.

Authors

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US Army

The authors would like to acknowledge the following individuals from the US Army. Their insight, support and technical expertise has been invaluable to the success of this program.

- **Wendy Balas, Paul Betts, Felix Cruz, Rene Kiebler, Pai Lu, Keith Messenger, Steve Nicolich, Charlie Patel and Jim Rutkowski.**

Iowa Army Ammunition Plant

The authors would like to acknowledge the following personnel at the Iowa Army Ammunition Plant for their assistance in this program. Their production insight, assistance in processing the artillery fills and the use of their facilities has been very beneficial to this program.

- **Tim Benson, Pete Clark, Rob Dautermann, Tom Rudy**