Insensitive Munition and Warheads Performance Testing of PAX-3

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Outline

- ***Background***
- ***Candidate Explosives***
- ***Testing for Down-Selection***
- ***Calculations***
- ***IM Testing***
- ***Conclusions***

Background

Objective: To Design a Warhead To Defeat both Armor and Structure Targets.

CURRENT SOLUTION
1 ARMOR WEAPON
1 BUNKER WEAPON

ONGOING WORK
1 WEAPON FOR ARMOR,
& BUNKER TARGETS

- High Explosive
  - Accelerate and move metal
  - High pressure applied quickly
  - Pressure pulse fades rapidly
- High *Blast* Explosive
  - Damage caused by overpressure
  - Less initial pressure pulse
  - Increased length of pressure pulse and pmpulse

Candidate Explosives

- *Hexal 70/30: RDX based, pressed*
- *HTA-3: HMX based, castable*
- *Aluminized Comp-A3: RDX based, pressed*
- *PAX-3: HMX based, pressed*
- *LX-14: Baseline*

Warhead Testing for Explosive Downselect (146mm Warhead)

- Long Stand-Off Testing for Jet Characterization
  - PAX-3 produced straightest jets
  - PAX-3 had highest tip velocity
- Short Stand-Off for Penetration Performance
  - PAX-3 had excellent penetration results
    - Pax-3 demonstrated 78% of LX-14 performance
    - Twice that of other high blast explosives
- Blast Effect Against Concrete Walls
  - Larger through-hole than LX-14 baseline
  - PAX-3 created largest rear spall damage

PAX-3 146-mm Blast Effect

Bunker Defeat Test 81-mm

6" x 6" side timbers
4" x 4" top timbers

3' thick sand wall with interlocking sand bags

81-mm Warhead

Bunker Defeat Test 81-mm

PAX-3 Successfully Defeats Bunker!

Modeling & Simulation

- PAX-3 was downselected for further evaluation after successful 146-mm and static 81-mm bunker testing
- CALE Modeling and Simulation
  - Performed on 81-mm and 72-mm warhead designs
  - Optimized jet performance and characterization
- 81-mm and 72-mm loaded with PAX-3
  - Analyze and compare actual data with models for penetration performance and jet characterization.

CHEETAH Calculations of PAX-3

COMPOSITION: **PAX-3 Variations** 6.5% CAB, 9.5% BDNPA/F 84% (HMX + Aluminum)	**Density** 99%TMD (g/cc)	**CJ Pressure** GPa	**Detonation Velocity** (km/s)	**Expansion Energy** @V/V0=6.5 $E_{6.5}$ (kJ/cc)	**Total Mechanical Energy** E_{tot} (kJ/cc)
0% Al	1.760	29.7	8.34	7.74	9.39
10% Al	1.810	28.3	7.99	8.52	11.13
15% Al	1.835	27.4	7.73	8.83	12.01
18% Al	1.851	27.1	7.65	8.94	12.58
19% Al	1.857	26.9	7.64	8.95	12.78
20% Al (PAX-3)	1.862	26.6	7.63	8.94	12.98
25% Al	1.890	24.8	7.58	8.73	13.86
28% Al	1.906	23.5	7.51	8.47	14.10
30% Al	1.918	22.6	7.47	8.17	14.01

20% Aluminum Gives Good Balance

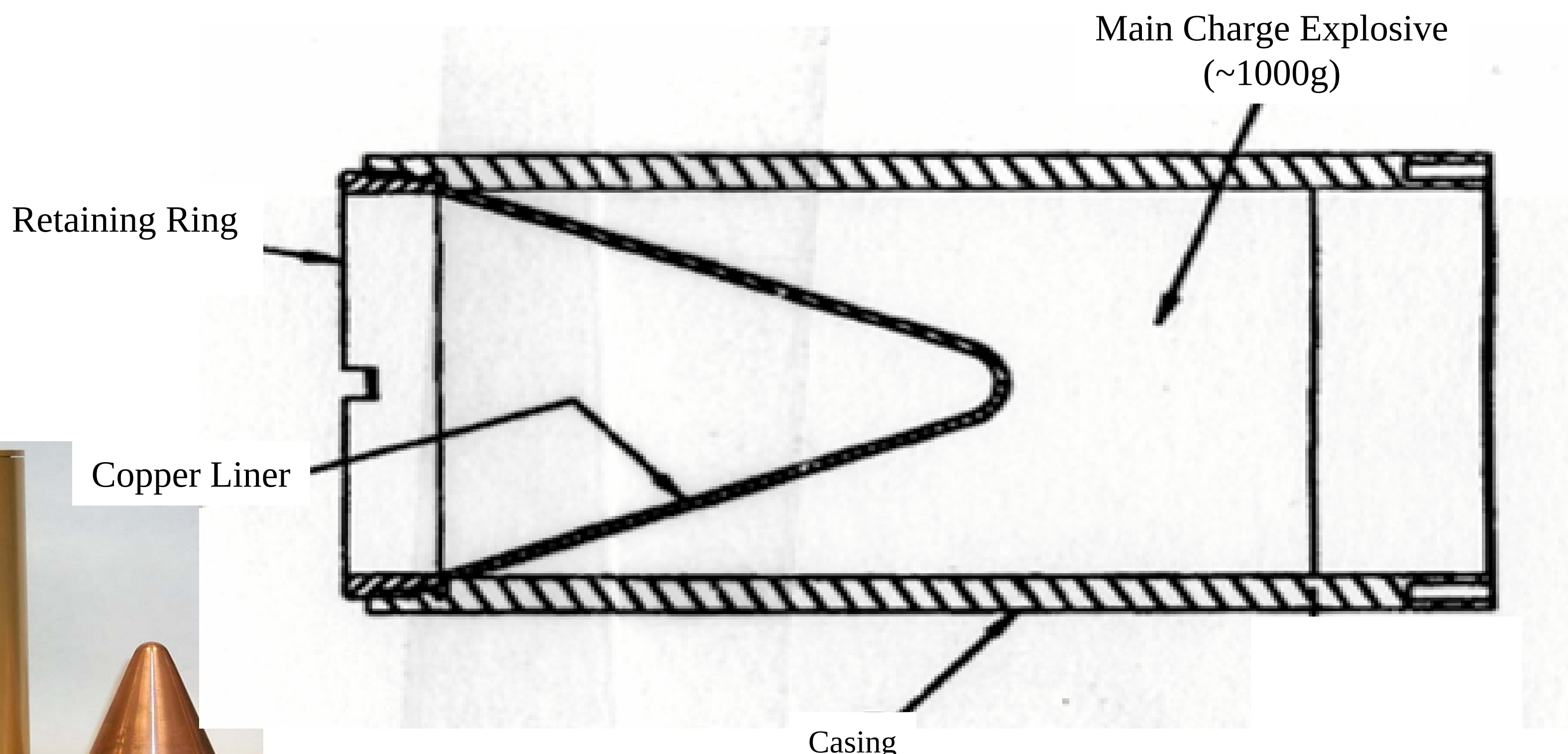
PAX-3 Sensitivity Data

Test	PAX-2A	PAX-3
		
ABL Impact	6.9-11 cm	6.9-11 cm
ABL Friction	800@ 8ft/sec	800@ 8ft/sec
Unconfined ESD	> 8 J	> 8 J
SBAT	365°F	360°F
NOL card gap	137 - 123	124

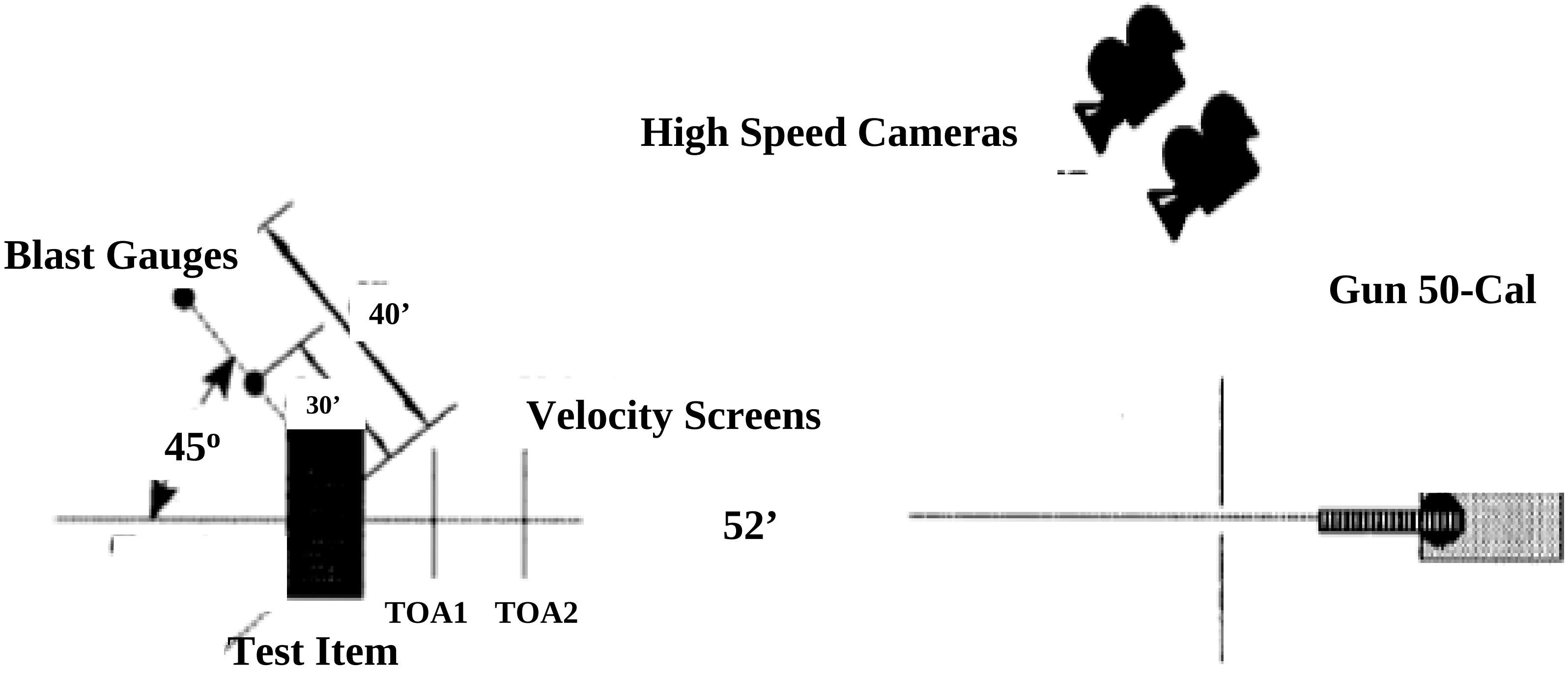
Small Scale Sensitivity Data indicates NO Safe Handling Issues!

IM Testing

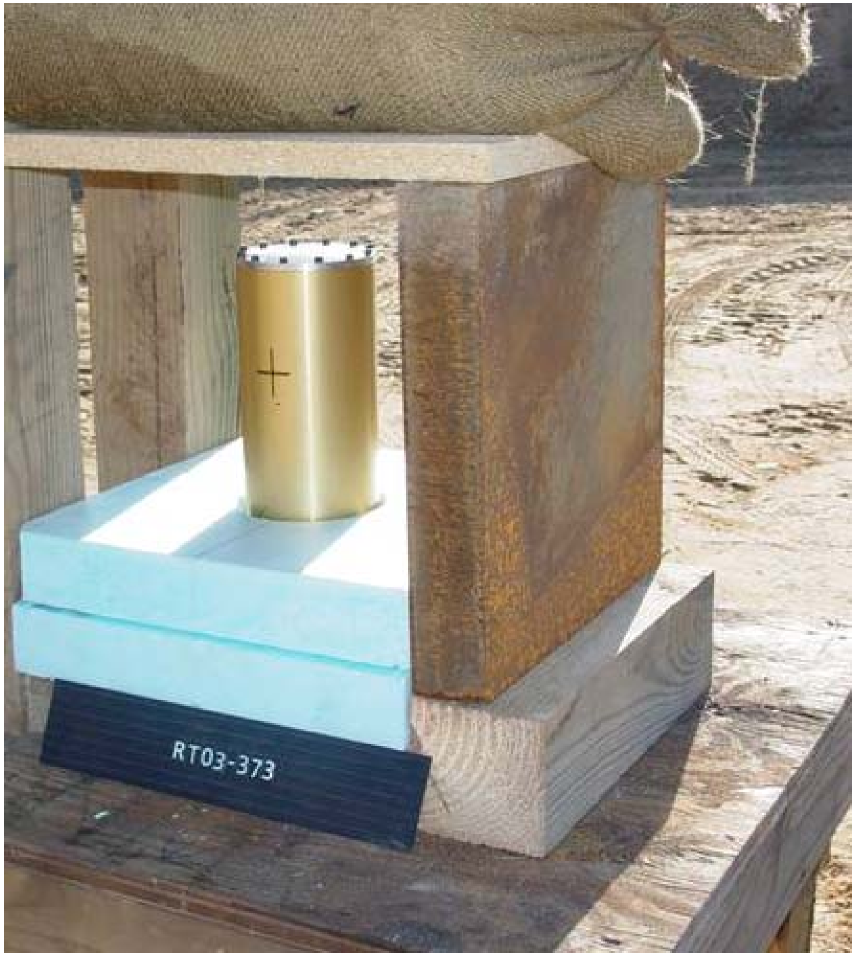
A series of IM tests were conducted on PAX-3 in a 81-mm Generic Shape Charge. IM tests chosen for evaluation were bullet impact (BI), fragment impact (FI), fast cook-off (FCO), and slow cook-off (SCO).



Bullet Impact Set-Up



Bullet Impact



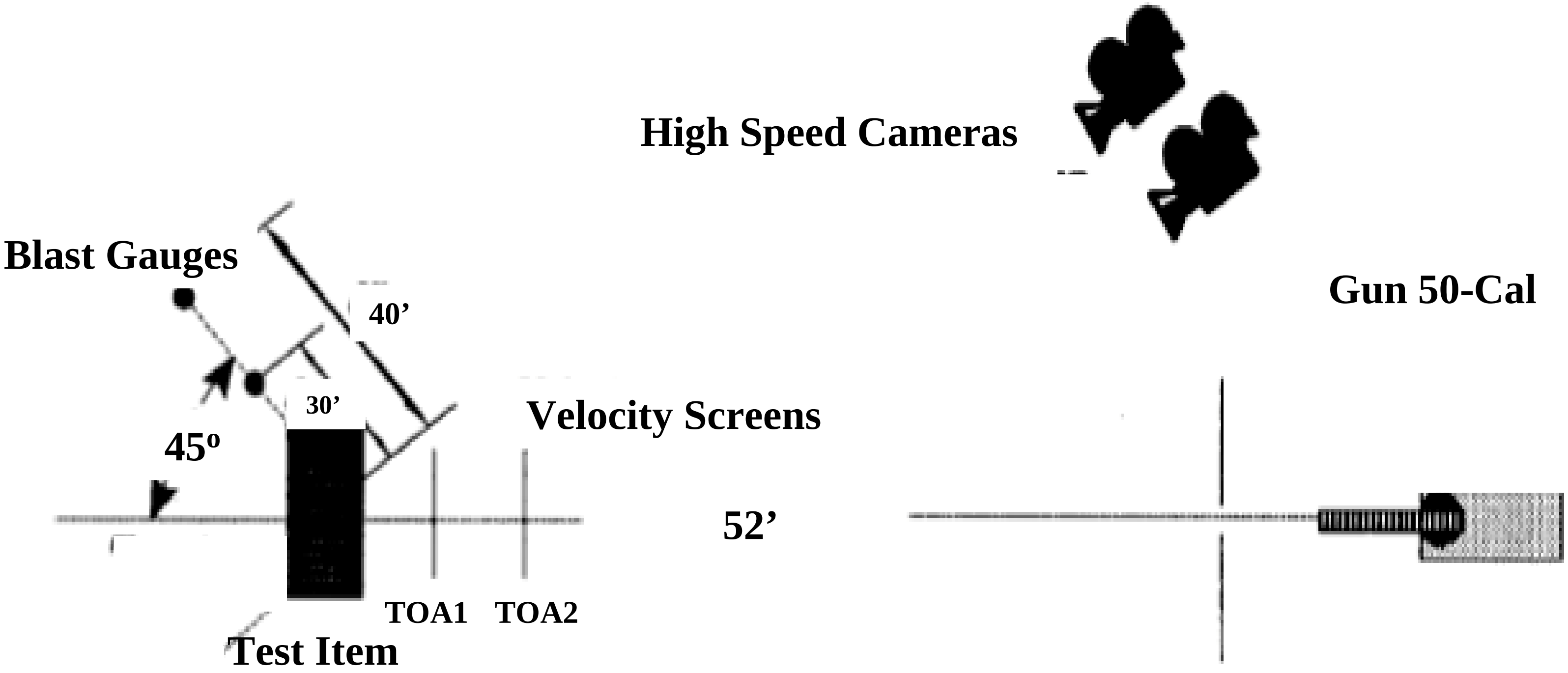
Bullet Impact

Un-reacted PAX-3

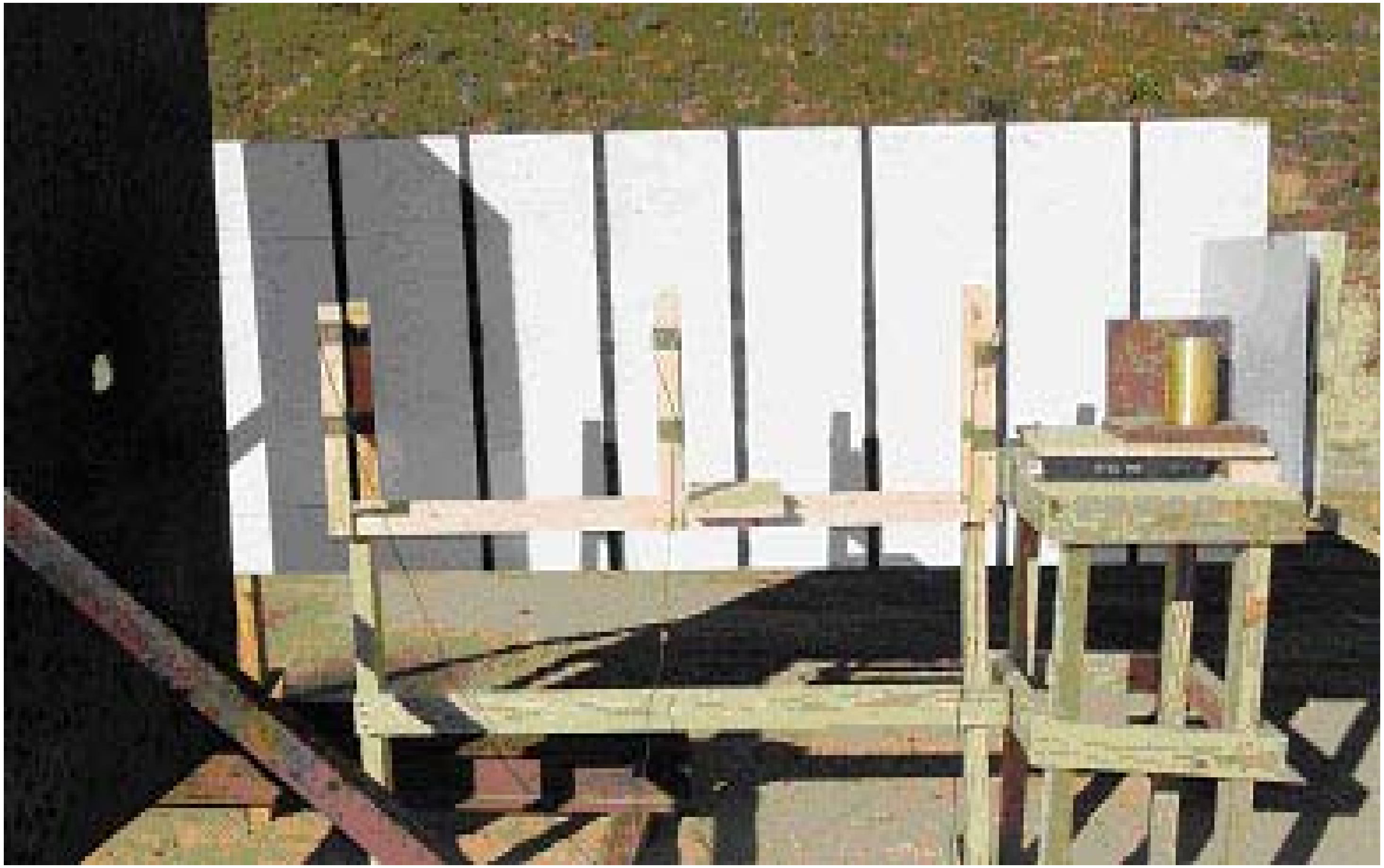
Virtually All PAX-3 Explosive Recovered

PASSED!

Fragment Impact Set-Up



Fragment Impact Set-Up



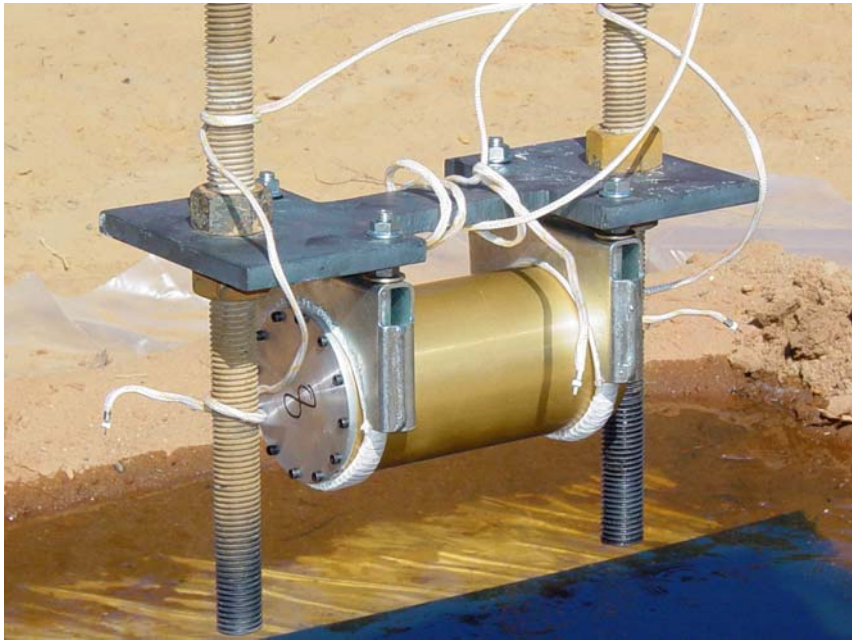
Fragment Impact

Un-reacted PAX-3

Virtually all Unexploded Ordnance Recovered

PASSED!

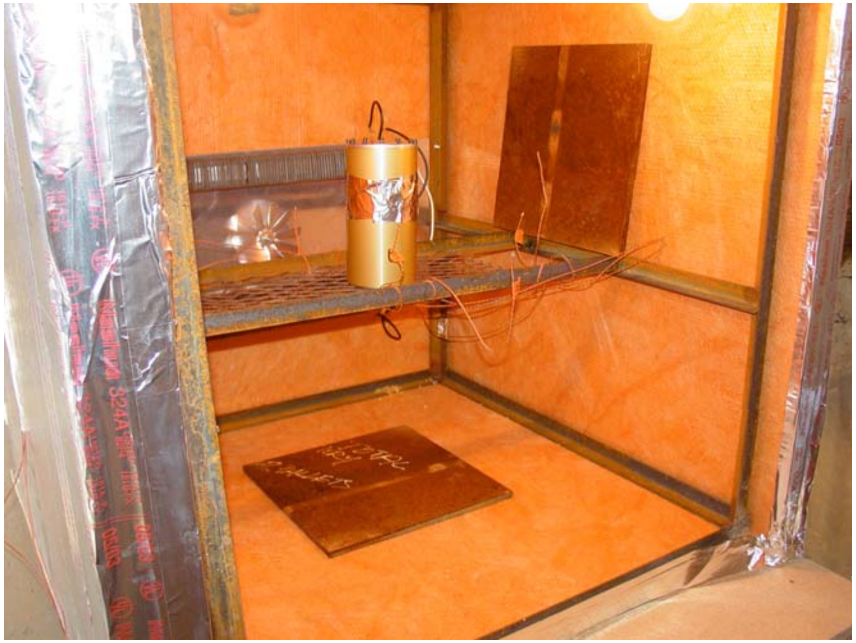
Fast Cook-Off Set-Up



Fast Cook-Off

Type V Reaction – Burn
PASSED!

Slow Cook-Off Set-Up



Type III and Type IV Reaction – Explosion/Deflagration
Case Venting Can Fix This Reaction

Conclusions

- Successfully designed and demonstrated single high penetration/high blast warhead
- PAX-3 explosive was downselected from a group of high blast explosives through experimentation and testing
- Allows for a single multipurpose design to be fielded with armor defeat and enhanced blast capabilities
- PAX-3 was shown to be IM compliant