



TECHNOLOGY DRIVEN. WARFIGHTER FOCUSED.

Cook-Off Mitigation Scaling Effects

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Outline



- Background
- Comp B Geometric Scaling
 - Small/Large Scale Hardware
 - Single hole
 - Multiple Vent Holes
- Full Scale Generic Hardware
 - Inert and Comp B Modeling
 - PBXN-109 Analytic Burn Modeling
 - Cast cure liner material investigation
- Conclusions



Background



- PEO Ammunition and RDECOM-ARDEC:
- Developing and Applying IM Warhead Venting Technology
- Maintaining structural requirements and warhead performance
- Lacking standard explosives venting characterization and quantification



Small Scale Laboratory Fixture

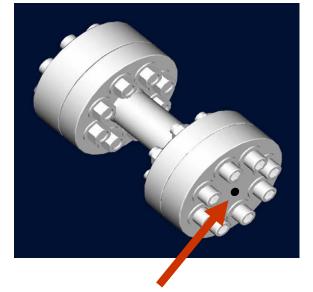


Heating bands

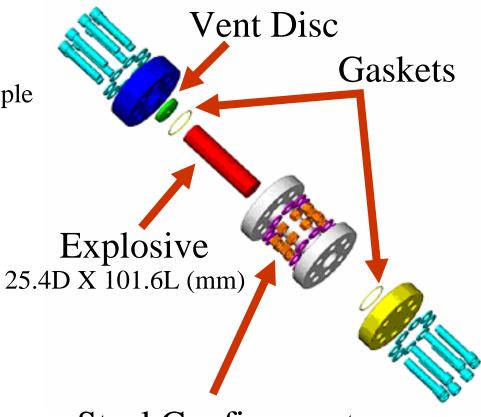
Vent location

Thermocouple leads

Assembled fixture



Adjusted Vent Hole



Steel Confinement



Large Scale Laboratory Fixture

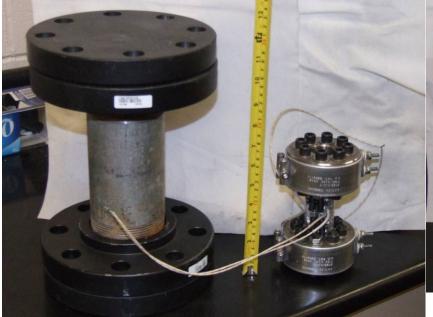




Explosive

Heating Bands

Large and Small Scale Hardware





TECHNOLOGY DRIVEN. WARFIGHTER FOCUSED.



RDECOM Composition B - Geometric Scaling Single Vent Hole



Small Scale-0.45



Large Scale



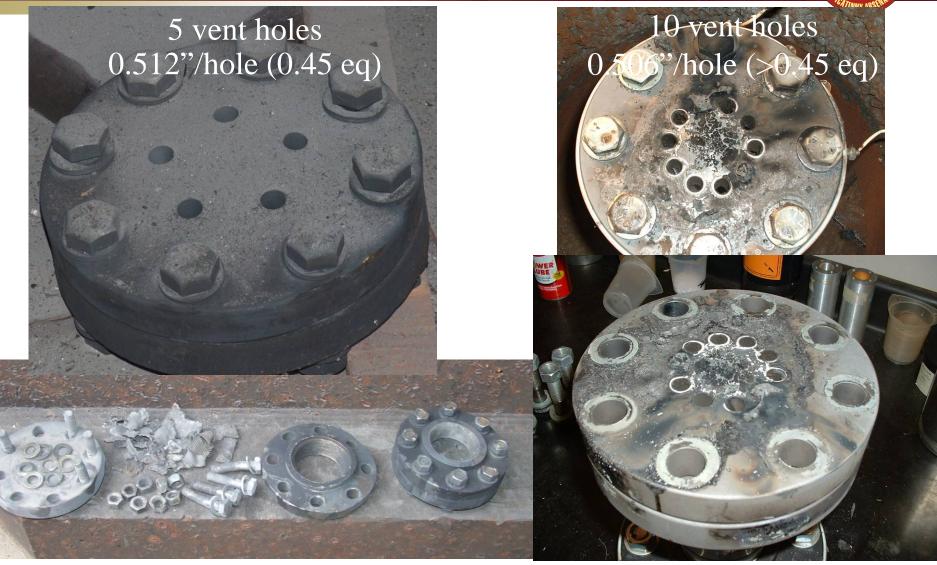


No Go DRIVEN. WARFIGHTER FOCUSED.



Composition B Multiple Vent Hole







Comp B Experimental Results



Small Scale Go Size(in) 370 Small Scale Go 0.2 Explode 400 Small Scale Go 0.2 Fixture on Side, Violent, Bolts sheared, Center Burst 379 Small Scale Go 0.4 Explode, top end plate came off 376 Small Scale No Go 0.4 Burn Off 390 Small Scale No Go 0.4531 Burn Off 390 Small Scale No Go 0.5 Burn Off 415 Small Scale No Go 0.5 Burn Off 400 Small Scale No Go 0.8 Fixture on Side, Burn Off, Fixture in one piece 378 Large Scale No Go 1.15 Scaled up Venthole as a function of total surface area	Scale	Go/No	Vent	N ote s	$T({}^{o}F)$
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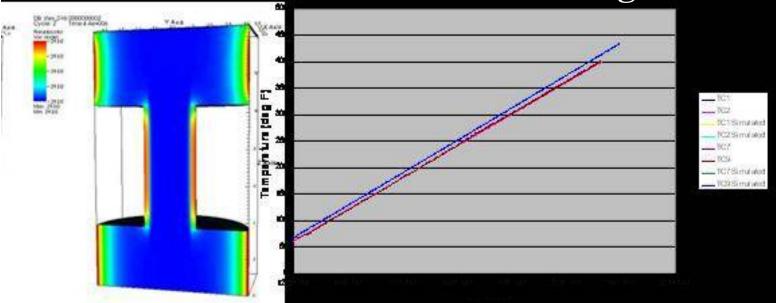
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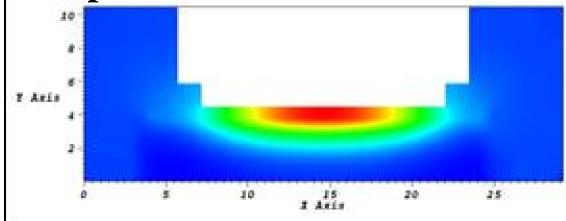
Inert and Comp B Modeling







Composition B Generic Hardware Modeling

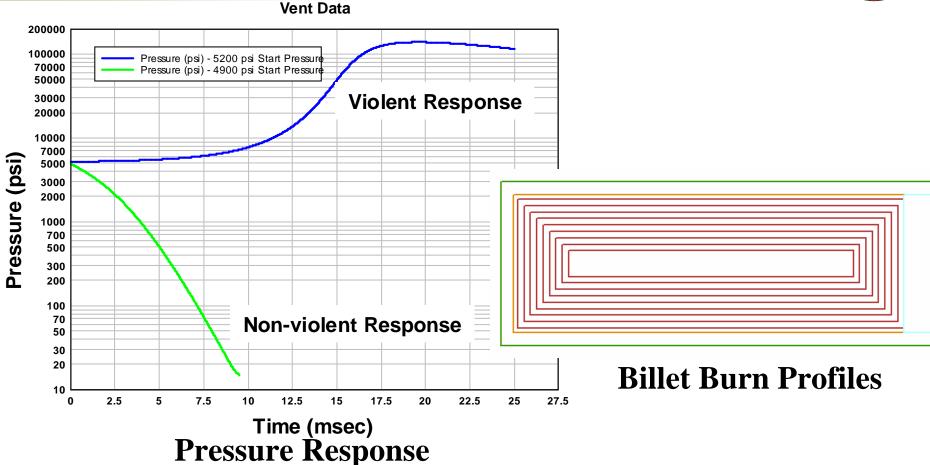


WARFIGHTER FOCUSED.



RDECOM PBXN-109 Analytic Burn Modeling





Modeling results predict that a very small vent area is required

- -Assumes clear vent path for gas products to escape
- -Indicates liner material viscosity is important



Cast Cure Liner Material Investigation

PBXN-109 – AHM Liner Testing



AHM=Asphaltic Hot Melt Very low viscosity when melted!

PBXN-109 HDPE Liner Testing



HDPE= High Density Polyethylene (Higher viscosity than AHM)

Identical single hole vent:

AHM liner: not violent

HDPE liner: violent

TECHNOLOGY DRIVEN. WARFIGHTER FOCUSED.



Conclusions



Melt Pour High Explosives:

- Direct Scaling based on billet surface area for the required vent area determination
- Required vent area increased with increased number of vent holes
- Vent area requirement using subscale and large scale fixtures used to develop venting solutions for full sized ordanance systems

Solid High Explosives

- Analytic burn modeling indicates that very small vent areas can be successful, but a clear path for gas products is required
- Melt liner viscosity is a critical factor in reducing vent area required
- Variety of melt pour, cast cure and pressed explosives testing
 - Comp B, PAX-28, PBXN-109, PBXN-9 have been vent tested with and without liners
 - Very little data exists for the burning behaviors at high temperature