

GENERAL DYNAMICS

Ordnance and Tactical Systems

120MM IMHE-T®

AN IM SOLUTION FOR CURRENT AND FUTURE OPERATING ENVIRONMENTS

**Presented By: Jason Gaines, Systems Engineer
2009 NDIA IMEM Technology Symposium**



120mm IMHE-T[®] Program Background

- GD-OTS and Nammo teamed together in 2002 to develop a low cost, IM compliant high explosive round of tank ammunition.
- IMHE-T[®] has Multi-Purpose (MP) capability against a target set that includes bunkers, reinforced concrete walls, light armor and personnel.
- Currently in Qualification for Norwegian Ministry of Defense.
- FMS program for Government of Egypt to begin Q3 2009



120mm IMHE-T[®] MOUT Target Performance

8" Double Reinforced Concrete Wall



Infantry Bunker



F-350

Truck



1" Steel Plate with Container



Adobe Brick Wall

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In insensitive Munitions (IM) Objectives

IM Test	Test Spec.	Passing Criteria
Slow Cook Off (FCO)	STANAG 4382	TYPE V
Fast Cook Off (SCO)	STANAG 4240	TYPE V
Bullet Impact	STANAG 4241	TYPE V
Sympathetic Reaction	STANAG 4396	TYPE III or better
Shaped Charge Jet Impact	STANAG 4526	TYPE III or better

Reaction Descriptions

Type	Description
I	Detonation
II	Partial Detonation
III	Explosion
IV	Deflagration
V	Non-Propulsive Burning



Systems Approach to IM Design

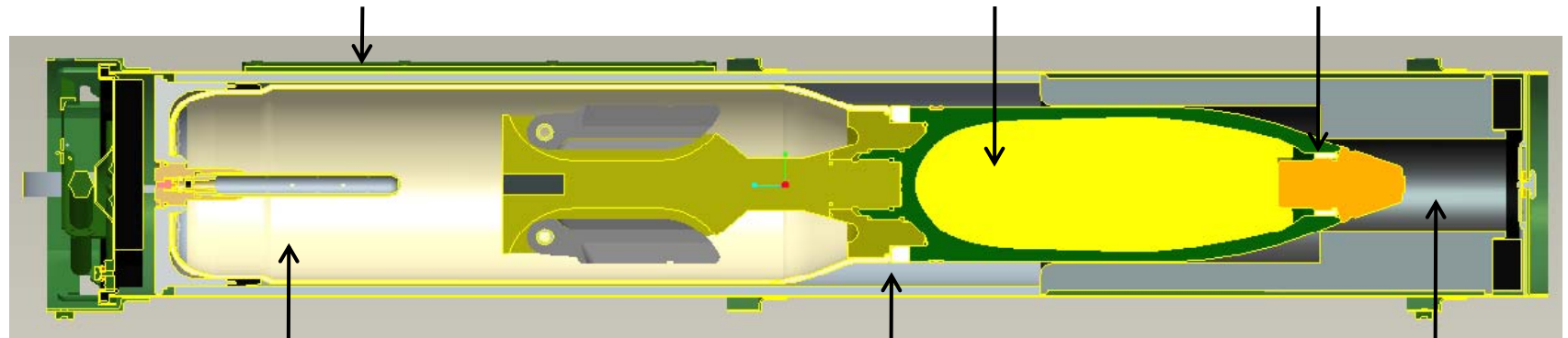
Key IM Design Concepts

1. Energetics must have good IM properties such as insensitivity to external shock and thermal stimuli.
2. Must eliminate all pressure build up caused by energetic confinement.

PA171 Vented Ammo Container

OSX 8 Explosive

Plastic Venting Sleeve



Closed Cell Foam Packaging

GD-OTS Hybrid Propellant

Fuze Relief Area



OSX-8 High Explosive

- ❑ Low Cost IM Explosive
- ❑ DNAN Based Explosive
 - Incorporates HMX and NTO
 - Comp B performance
 - Low Shock Sensitivity
 - Excellent IM Properties
- ❑ Produced by BAE Holston using existing equipment/facilities
- ❑ Utilizes existing melt pour LAP facilities
- ❑ Interim Qualification Status



HYBRID Propellant

State-of-the-art in Propellant Technology for Small, Medium and Large Caliber Ammunition

Excellent IM Characteristics
Low sensitivity to external shock or thermal stimuli

All Qualification Testing Complete

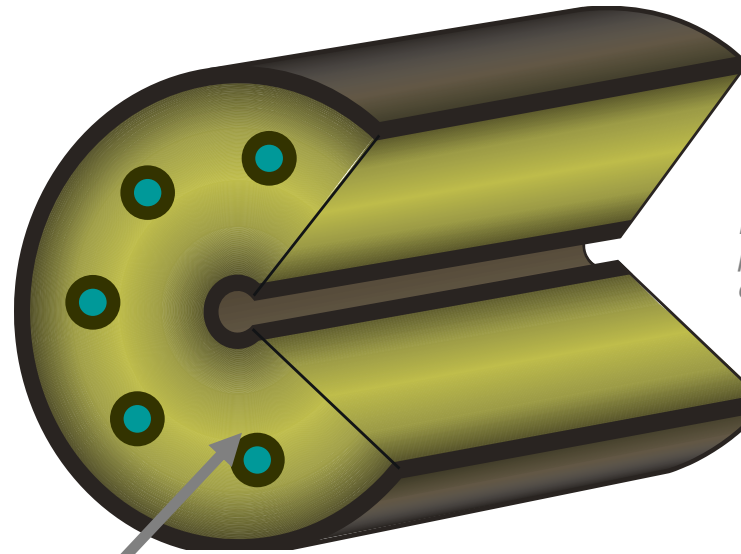


Illustration of a propellant grain cross section

Deterrent Layer - applied to tailor the burn rate for specific applications to optimize ballistic efficiency



IM Test Series IAW MIL-STD 2105 C

(Conducted in July 2007 – Feb 2009 by GD-OTS and Nammo)

IM test:

- Slow Cook-off
- Fast Cook-off
- Bullet Impact (HE and Pro.)
- Shaped Charge Jet (HE and Pro.)
- Sympathetic detonation

Req. Type

5

5

5

Pass (3-5)

Pass (3-5)

Environmental Test Sequence:

- 28 day T & H
- Vibration
- 4 day T & H
- 12 meter drop test

-

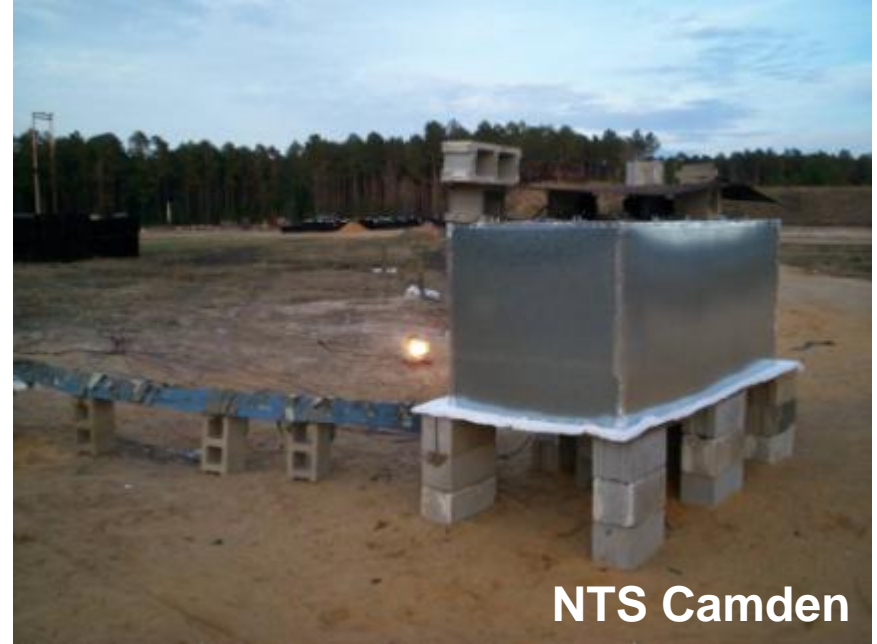
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Safe to dispose



Slow Cook Off Test Setup, Aug '07



Packaged Munition placed in an insulated oven.
Temperature is ramped to 50°C over a period of 1 hour and stabilized
Temperature is then ramped at a rate of 3.3°C per hour until reaction occurs



Slow Cook Off Test 1 Results, Aug '07

(with polycarbonate venting sleeve)



Result: **Type 3** reaction, explosion

Reaction of propellant occurred at 130°C, (266°F)

Reaction of explosive occurred at 187°C, (370°F)

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Slow Cook Off Test 2 Results, Dec '07

(with HDPE venting sleeve)



Pass



NTS Camden

Result: **Type 5** reaction, burning only

Reaction of propellant occurred at 130°C, (266°F)

Reaction of explosive occurred at 186°C, (367°F)

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Fast Cook Off Test 1 Setup, Aug 07

(with Polycarbonate venting sleeve)

Packaged munition placed above 1000 gallons of Kerosene.



NTS Camden

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Fast Cook-off Test 1 Result, Aug '07

(with Polycarbonate venting sleeve)



Result: **Type 4** Reaction
Propulsive reaction of warhead

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Fast Cook Off Re-Test Setup, July '08

(with HDPE venting sleeve)

Filled warhead w/ inert fuze, placed above 1000 gallons of Kerosene



GD-OTS Rockhill Test facility

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Fast Cook-off Test Results, July '08

(with HDPE venting sleeve)



Result: **Type 5** Reaction at 22 min.

GD-OTS Rockhill Test facility

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Bullet Impact Test Setup, Aug '07

Conducted two (2) BI tests

Test 1 – Three (3) round burst of 12.7 mm AP rounds fired at center of the warhead.

Test 2 – Three (3) round burst of 12.7 mm AP rounds fired at center of the propellant bed.



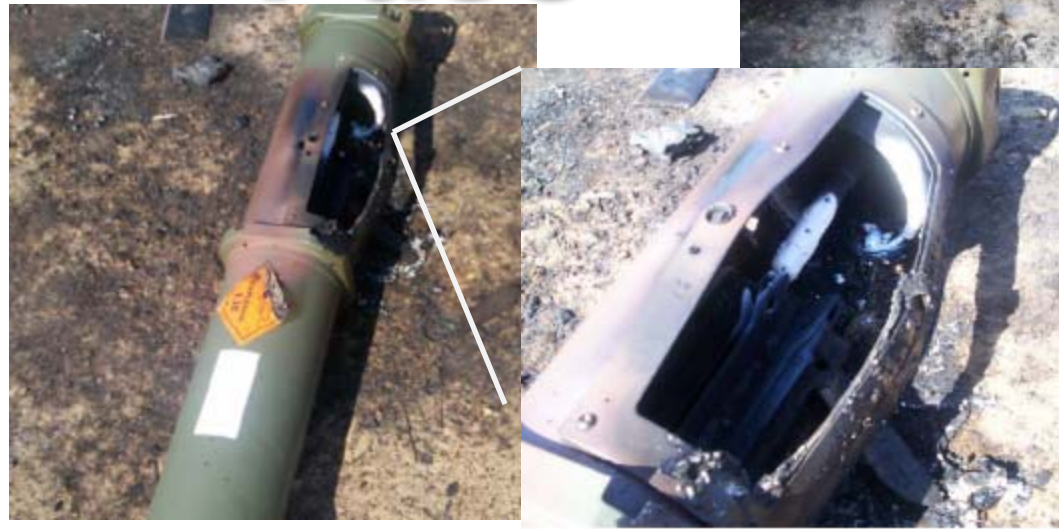
Bullet Impact Test Results, Aug '07

Shot to the *warhead*
Type 5



Pass

Shot to the *propellant*
Type 5



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Sympathetic Detonation Test Setup, Feb '09



Nammo Test Facility

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Sympathetic Detonation Test Results, Feb '09



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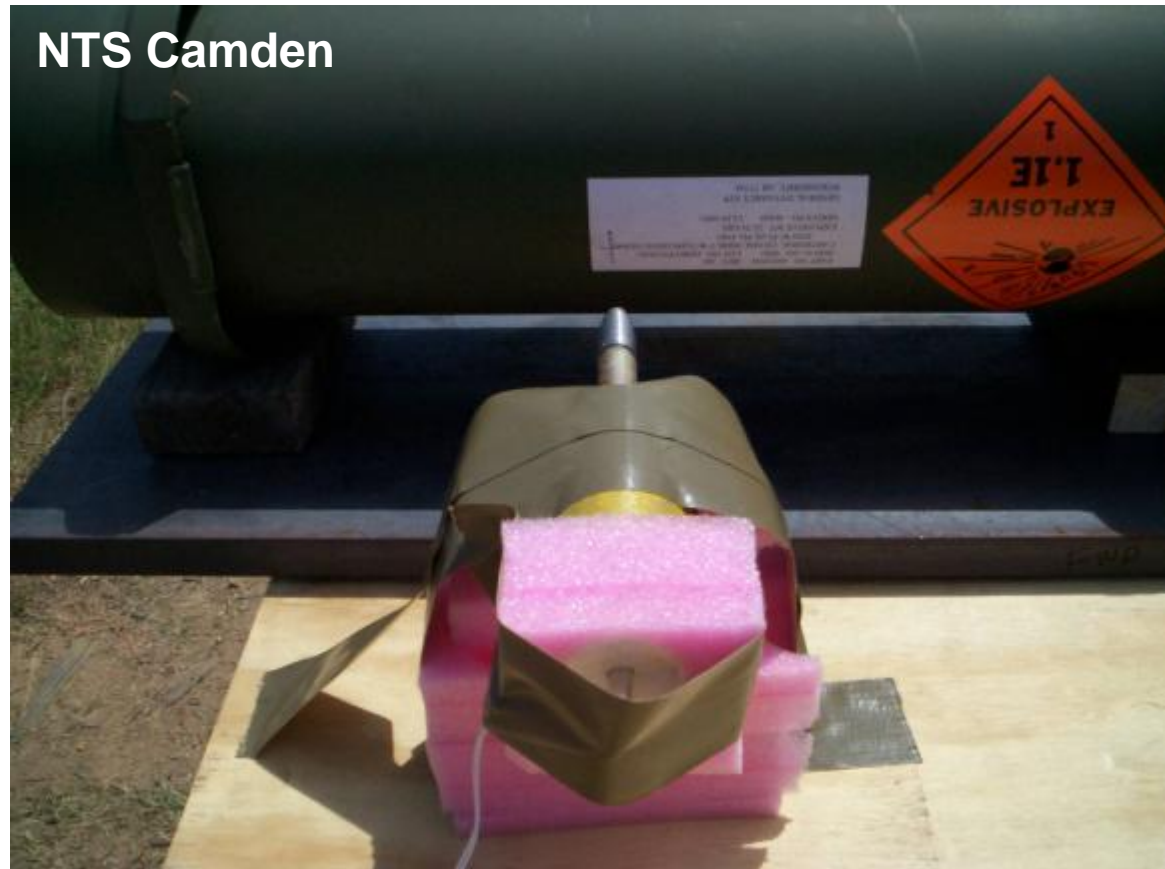


Shaped Charge Jet Test 1 Setup, Aug '07

Conducted two (2) SCJ tests

Test 1 - 50 mm Rockeye SCJ
fired directly into warhead

Test 2 – 50 mm Rockeye SCJ
fired directly into propellant bed.



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Shaped Charge Jet Test 1 Results, Aug '07

Aft piece of warhead



Forward piece of warhead



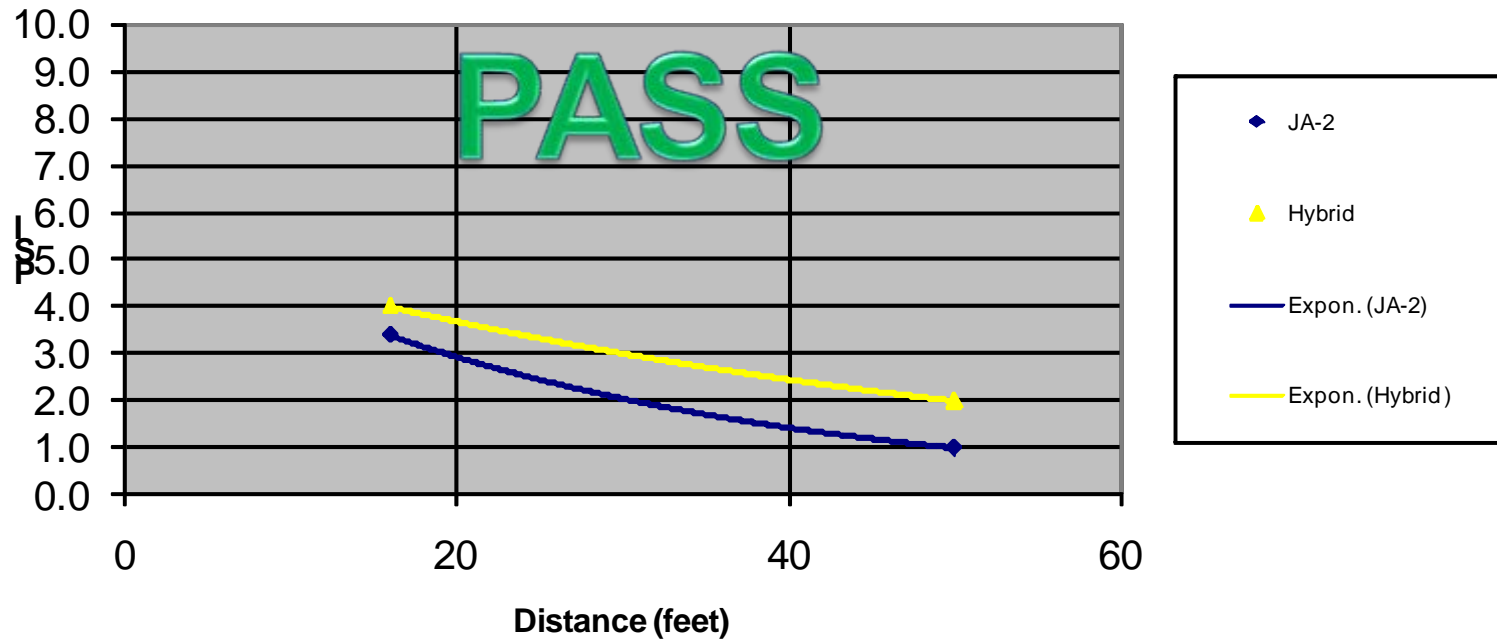
PASS

Steel Witness Plate



Shaped Charge Jet Propellant Results, Jan '08

Hybrid and JA2 Reactions to 50mm SCJ
Unconditioned in PA171 Ammunition Can



Environmental Test Sequence

28-Day Temperature and Humidity Test

Hot Cycle: +63°C at 95% RH
Cold Cycle: -40°C

Three (3) Rounds in Packaged Configuration

Pass

Transportation Vibration Test Sequence

Two-Wheeled Trailer Vibration
Shipboard Vibration
Exploratory Vibration
Variable Frequency
Endurance

Pass

4-Day Temperature and Humidity Test

Hot Cycle: +63°C at 95% RH
Cold Cycle: -40°C

Pass

12 Meter Drop Test

Round 1: Vertical (nose down)
Round 2: Vertical (base down)
Round 3: Horizontal

Pass

Remove and Inspect

Remove and Inspect

Remove and Inspect



IMHE-T IM Test Summary

IM Test	Test Spec.	Passing Criteria	Results
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Bullet Impact	STANAG 4241	TYPE V	Type V
Sympathetic Reaction	STANAG 4396	TYPE III or better	Pass
SCJ Impact	STANAG 4526	TYPE III or better	Pass

The 120mm IMHE-T has successfully completed all customer IM requirements



Path Forward and Conclusions

- The 120mm IMHE-T[®] will be considered fully IM compliant without waivers or deviations upon successful completion of testing this summer.
- Successfully meets all ballistic and lethality requirements without compromising crew survivability.
- Currently in Leopard II Qualification for Norwegian Ministry of Defense – June Completion
- FMS Case for Abrams set to begin Q3 2009.



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