



IM Explosive for SMAW HEAA Warhead

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Presentation Outline

- Objectives
- Approach
- System Description
- Explosive Selection
- Qualification and Performance Tests
- Summary
- Acknowledgements



Objectives

- Replace SMAW HEAA warhead fill (Octol) with explosive of comparable performance and improved IM characteristics
 - Sponsor directive: only system change will be explosive fill
- Meet current HEAA penetration requirements
- Qualify SMAW HEAA with IM warhead fill (SMAW HEAA-IM Warhead)

Approach

- **Phase I: Explosive Selection**
 - Explosive Selection Committee
 - IM and Performance Testing in SMAW HEAA Warhead
 - Downselection to Final Explosive Fill
- **Phase II: Qualification and Performance Testing SMAW HEAA-IM Warhead**

SMAW HEAA System Description

- Shoulder-launched Multi-purpose Assault Weapon High Explosive Anti-Armor
- DODIC HX06
- Effective against medium armor
- SMAW HEAA consists of:
 - MK 153 MOD 0 Launcher
 - SMAW HEAA Encased Assault Rocket (EAR)
- SMAW HEAA Rocket consists of:
 - Rocket motor
 - Impact fuze
 - Shaped charge, high explosive warhead





Selection of IM Explosive Candidates





Explosives Assessment

- Explosive Output
- IM Survivability
- Safety & Reliability
- Producibility / Life Cycle Costs





Explosive Candidates

- PBXN-9
 - Used in Navy & Army shaped charge ordnance
 - Good IM in FCO/SCO/BI
 - Bad IM in FI

- PBXN-11
 - Better performance than PBXN-9
 - Good IM in FCO/SCO
 - Bad IM in BI/FI

- PBXW-114
 - Equivalent performance to PBXN-110
 - Good IM in FCO/SCO/BI
 - Potential for significant improvement in FI



Explosive Properties

Explosive	Composition	Manufacture Method	Density, g/cc	FCO/SCO/BI
PBXN-9	HMX/binder	pressed	1.73	V/V/V
PBXN-11	HMX/binder	pressed	1.80	V/V/IV
PBXW-114	HMX/Al/binder	cast	1.71	V/V/V
Octol	HMX/TNT	melt (sedimentation) cast	1.82	I/V



Phase I. IM and Performance Tests

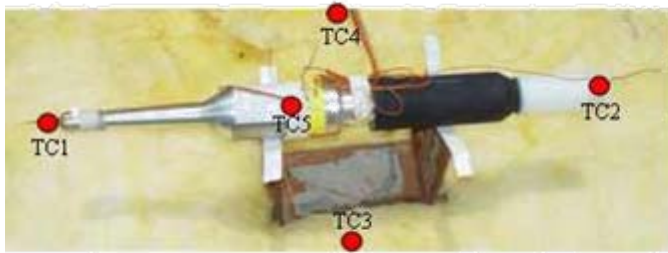


Phase I Testing

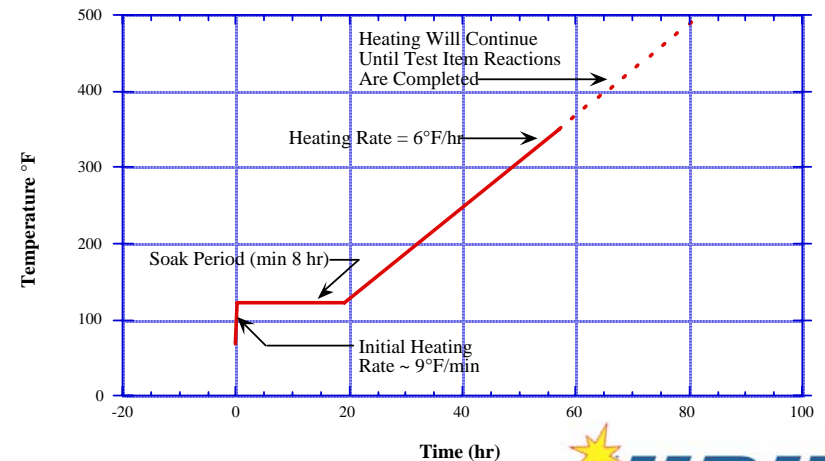
- Slow Cook-Off
 - 2 warheads of each explosive fill plus Octol baseline
 - Tests performed at Dahlgren Division, NSWC
- Fragmentation Impact
 - 2 warheads of each explosive fill plus Octol baseline
 - Tests performed at Dahlgren Division, NSWC
- Penetration
 - 3 warheads of each explosive fill (2 for PBXN-11) plus Octol baseline
 - Tests performed at Dahlgren Division, NSWC
- Flash X-ray
 - 2 warheads of PBXN-9 and PBXW-114 fills plus Octol baseline
 - No PBXN-11 loaded warheads available
 - Tests performed at ARL, Aberdeen, MD



Slow Cook-Off Test



- MIL-STD-2105C (STANAG 4382)
- 2 tests per explosive candidate and Octol baseline
- Live warhead, other components were inert mass simulates
- Six thermocouples recorded temperatures
- Tests were continuously monitored by two video cameras
- Photographs of test set-up and post test results taken



Slow Cook-Off Results

Explosive	Reaction
PBXN-9	Type IV (Deflagration)
PBXN-11	Type V (Burn)
PBXW-114	Type IV (Deflagration)
Octol	Type I (Detonation)



PBXN-11 post test



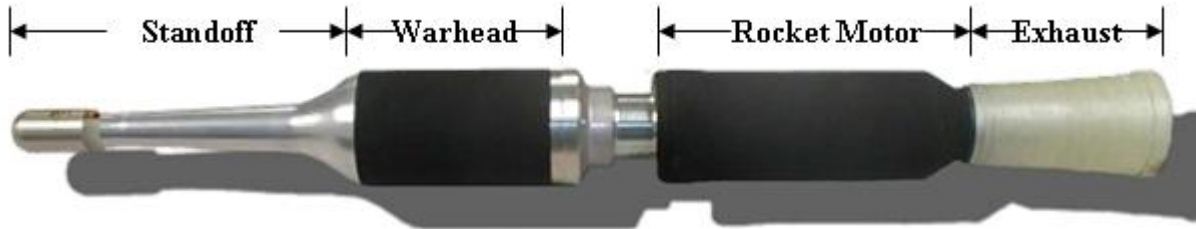
Octol post test

Slow Cook-Off



Liner Ejected from Warhead in all SCO tests of Explosive Candidates

Fragment Impact Test



- MIL-STD-2105C (STANAG 4496)
- 2 tests per explosive candidate and Octol baseline
 - Fragment velocity ~8000 ft/sec first test; ~6000 ft/sec second test
- Live warhead, other components were inert mass simulates
- Pressure gauges @ 15', 22' and 34'
- 3 Foil velocity screens measured fragment velocity
- Test recorded using digital Phantom cameras

Fragment Impact Results



Explosive	Reaction
PBXN-9	Type I (Detonation)
PBXN-11	Type I (Detonation)
PBXW-114	Type I (Detonation) & Type IV (Deflagration)
Octol	Type I (Detonation)



Warhead Penetration Tests

- 3 Tests per explosive candidate and Octol baseline
 - Except only 2 PBXN-11 warheads available
- Test continuously monitored by a video cameras
- Photographs of test set-up and post test results taken

<u>Explosive</u>	<u>Average Penetration</u>
PBXN-9	passed
PBXN-11	passed
PBXW-114	failed
Octol	baseline





PBXN-11 Loading

- Problems encountered loading PBXN-11 charges
- PBXN-11 tended to adhere to case wall when pressed under conditions used for PBXN-9 charges and caused case deformation
- PBXN-11 charges for tests were pressed as free-standing billets, slipped into warhead case, and then pressed lightly
- Loading process improvement required if PBXN-11 selected



Summary of Phase I Results

Explosive	Density	Current Processibility	Penetration	IM Reactions		
				SCO	Frag Impact (T1 8000 ft/sec, T2 6000 ft/sec)	
PBXN-9	1.744	Yes	passed	IV (2) Deflagration	I (2) Detonation	
	1.744					
	1.750					
PBXN-11	1.769 *	No	passed	V (2) Burn	I (2) Detonation	
	1.803					
PBXW-114	~1.71	Yes	failed	IV (2) Deflagration	I (1) Detonation	IV (1) Deflagration
Octol	1.80-1.85	N/A	baseline	I (2) Detonation	I (2) Detonation	
* 98% TMD is 1.793 gm/cc. 1.769 is 96.7% TMD						



IM Explosive Selection

- PBXN-9 Selected
- Based on
 - Performed well in penetration tests
 - IM characteristics
 - Fielded as main charge in other shaped charge warheads
 - Drop in solution
- Place barrier tape between PBXN-5 booster and PBXN-9 explosive
- Informally refer to SMAW HEAA system with PBXN-9 warhead fill as “SMAW HEAA-IM Warhead”





Phase II. Qualification and Performance Tests for SMAW HEAA-IM Warhead



Qualification and Performance Tests

- Objectives
 - Ensure that SMAW HEAA-IM Warhead meets IM and Hazard Classification (HC) requirements
 - Obtain Final (Type) Qualification of the SMAW HEAA-IM Warhead
 - Verify that replacement of warhead fill has not caused degradation of system performance



Phase II Tests

- Test Items
 - Built by Nammo Talley, Inc.
 - Warheads loaded by IHDIV, NSWC
 - Liners are Government Furnished Material (GFM)
 - Mk 259 Fuzes are GFM
- Testing will be conducted by National Technical Systems (NTS), Camden, Arkansas during March – June 2009



Qualification Tests

Tests harmonized for IM and HC Purposes, but include only a limited subset of HC and FTQ tests, since this effort is only changing the warhead explosive fill and not safety features of the system

- Basic Safety Tests w/ Thermal Stability
- Sympathetic Detonation (Stack Test)
- Fast Cook-Off
- Slow Cook-Off
- Bullet Impact
- Fragment Impact





Phase II Test Matrix

INDIAN HEAD

	Configuration	Live WH w/ Booster	Rocket Motor		Fuze		Spotting Round		
			Live	Inert	Live	Inert	Live	None	
28-day T&H, Thermal Stability, Vibration, 4-day T&H, 40 ft. drop	Shipping Configuration	1		1		1	1		
		1		1		1	1		
		1		1		1	1		
28-day T&H, Thermal Stability, Vibration, 4-day T&H, Flight Performance Testing		1	1		1		1		
		1	1		1		1		
		1	1		1		1		
		1	1		1		1		
		1	1		1		1		
Flight Performance Testing (Baseline)		EAR	1	1		1		1	
		EAR	1	1		1		1	
Sympathetic Detonation - Confined Stack Test		Shipping Configuration	1		1		1	1	
			1		1	1		1	
	1			1	1		1		
	1			1	1		1		
	1			1	1		1		
	1		1		1		1		
Sympathetic Detonation - Unconfined Stack Test	Shipping Configuration	1		1		1	1		
		1		1	1		1		
		1		1	1		1		
		1		1	1		1		
		1		1	1		1		
		1	1		1		1		
Fast Cook Off	Shipping Configuration	1	1		1		1		
		1	1		1		1		
		1	1		1		1		
		1	1		1		1		
		1	1		1		1		
		1	1		1		1		
Fast Cook Off	EAR	1		1		1	1		
Slow Cook-Off	EAR	1		1		1		1	
	EAR	1		1		1		1	
Bullet Impact	EAR	1		1		1		1	
	EAR	1		1		1		1	
Fragment Impact	EAR	1		1		1		1	
	EAR	1		1		1		1	



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Phase II Test Matrix

(continued)

	Configuration	Live WH w/ Booster	Rocket Motor		Fuze		Spotting Round	
			Live	Inert	Live	Inert	Live	None
3 Month Aging, Penetration Testing	WH only	1						
	WH only	1						
	WH only	1						
6 Month Aging, Penetration Testing	WH only	1						
	WH only	1						
	WH only	1						
Vibration, Penetration Testing	WH only	1						
	WH only	1						
Baseline Penetration Testing	WH only	1						
	WH only	1						

Summary

- PBXN-9 selected as IM explosive for SMAW HEAA warhead
- Qualification test plan received concurrence from WSESRB, NOSSA, DDESB, and Navy, Army & Air Force Hazard Classification Offices
- Warheads have been loaded
- Test items have been built
- Qualification and performance testing is underway

Acknowledgments

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 - Technical Advisor: Tim Portner, Dahlgren Division, NSWC
- Test item build: Nammo Talley, Inc.
 - Project Manager: Will Betush
 - Project Engineer: Glade Hansen





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