



U.S. Army Research, Development and
Engineering Command



TECHNOLOGY DRIVEN. WARFIGHTER FOCUSED.

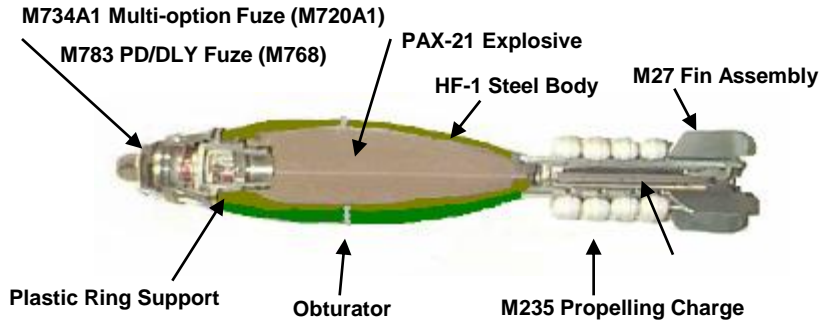
60/81mm HE Mortar IM Enhancement Program

Nickolas Baldwin

- **United States Code, Title 10, Chapter 141, Section 2389. Ensuring safety regarding insensitive munitions:**
 - The Secretary of Defense shall ensure, to the extent practicable, that insensitive munitions under development or procurement are safe throughout development and fielding when subject to unplanned stimuli.
- **Department of Defense Directive 5000.01, Enclosure 1 (Additional Policy)**
 - E1.1.23. Safety. Safety shall be addressed throughout the acquisition process. Safety considerations include human (includes human/system interfaces), toxic/hazardous materials and substances, production/manufacturing, testing, facilities, logistical support, weapons, and munitions/explosives. **All systems containing energetics shall comply with insensitive munitions criteria.**

Item Nomenclature

Cartridge, 60mm: HE, M720A1/M768

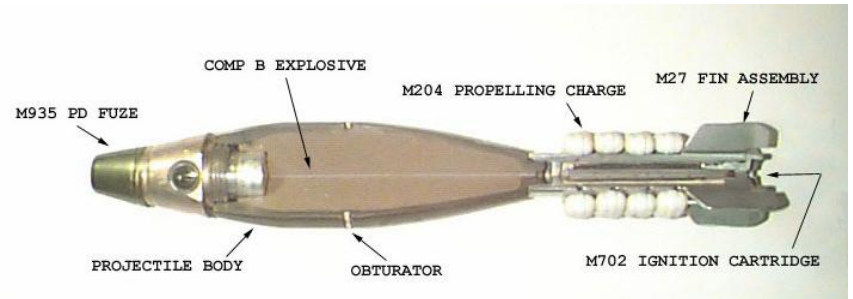


TC: OCT 01

MR: APR 06

Item Nomenclature

Cartridge, 60mm: HE, M888



Configuration Item	M720	M720A1/M768	M888
Fuze booster material	Comp A-5	PBXN-5	Comp A-5
Plastic fuze adapter	No	Yes	No
Explosive fill	Comp-B	PAX-21	Comp-B
Projectile body	1340 Steel	HF-1	1340 Steel
Propellant Charge	M204 (flake)	M235 (ball)	M204 (flake)
Fiber Tube	Short	Long	Short
Orientation	Fuze down	Fuze up	Fuze down

60mm HE Baseline IM Performance

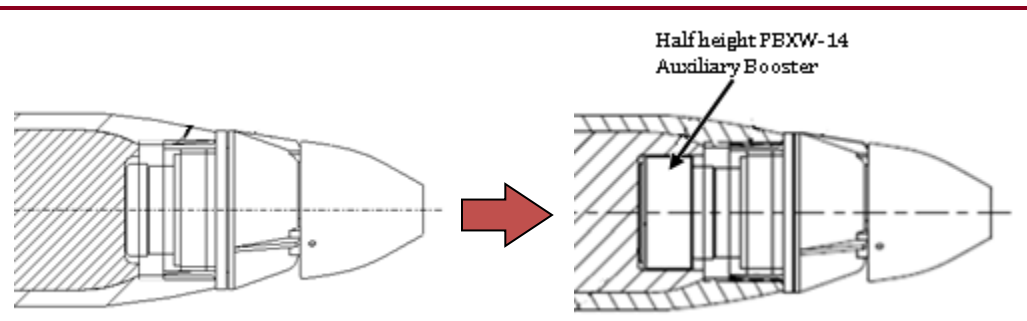
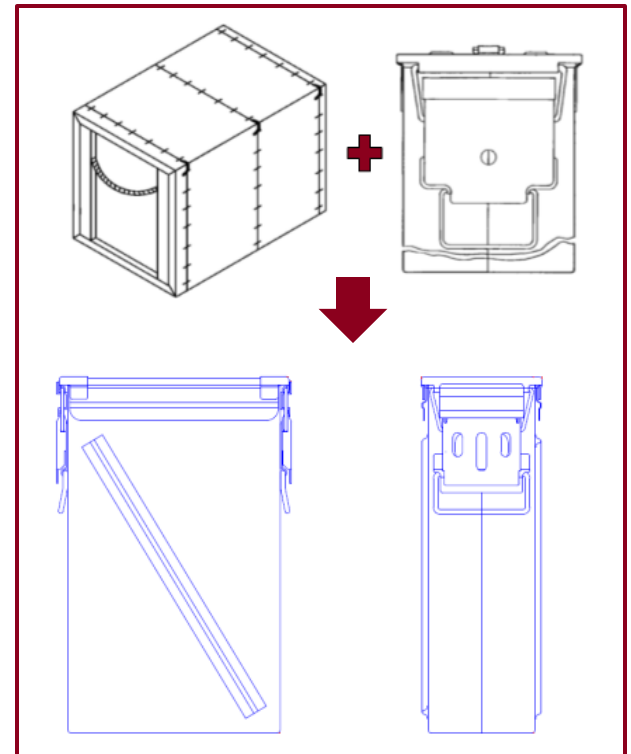
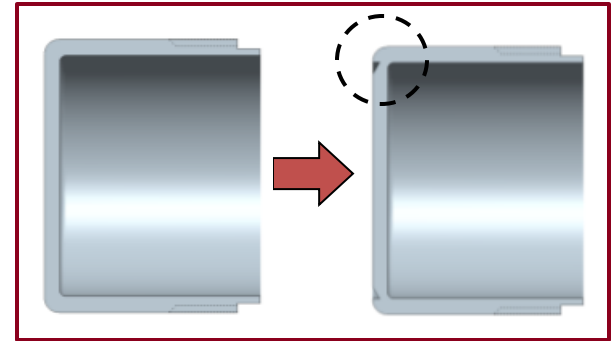
IM Test	FCO	SCO	BI	FI	SD	SCJI
Passing Criteria	V	V	V	V	III	III
M720 (Baseline)	II	III	V	III	F	F
M720A1/M768	V	II	V	III	F	F
M888	II	III	V	III	F	F

Reactions:

VI No Sustained Reaction	V Burn	IV Deflagration	III Explosion	II Partial Detonation	I Detonation
-----------------------------	-----------	--------------------	------------------	--------------------------	-----------------

60mm IM Path Forward

- M734A1/M783 Fuze (M720A1 & M768):
 - Maintain current PBXN-5 lead and booster
- M935 Fuze (M888)
 - Replace RDX lead with PBXN-5
 - Replace Comp A-5 booster with PBXW-14
 - Implement scored booster cup
- Maintain current plastic fuze thread insert
- Implement PBXW-14 auxiliary booster
- Adopt IMX-104 main charge.
- Packaging:
 - Maintain current longer fiber tube (PA189)
 - New metal can over pack (PA191).
 - Package all rounds nose up



- Assessed HF-1 and 1340 Steel with IMX-104 in 60mm.
- Results are promising with cheaper 1340 Steel → cost savings.

UNCLASSIFIED					
Normalized Lethal Area					
Personnel - AB	Range [m]	60mm			
		Pit Test Data (1340 / CompB)	Pit Test Data (HF1 / PAX21)	Pit Test Data (IMX-104 / HF1)	Pit Test Data (IMX-104 / 1340)
		500	1.00	1.11	1.04
	1000	1.00	1.11	1.04	0.95
	1500	1.00	1.11	1.04	0.95
	2000	1.00	1.12	1.05	0.95
	2500	1.00	1.13	1.05	0.94
UNCLASSIFIED					

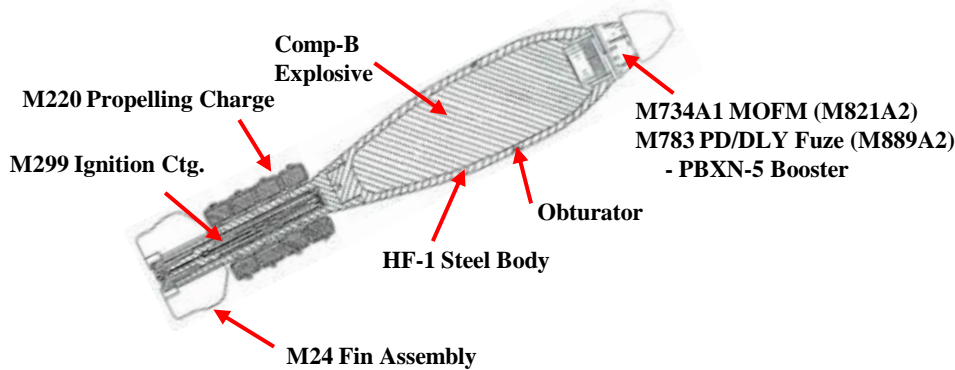
UNCLASSIFIED					
Normalized Lethal Area					
Materiel - AB	Range [m]	60mm			
		Pit Test Data (1340 / CompB)	Pit Test Data (HF1 / PAX21)	Pit Test Data (IMX-104 / HF1)	Pit Test Data (IMX-104 / 1340)
		500	1.00	0.86	0.98
	1000	1.00	0.86	0.98	1.02
	1500	1.00	0.86	0.98	1.02
	2000	1.00	0.86	0.98	1.02
	2500	1.00	0.86	0.98	1.02
UNCLASSIFIED					





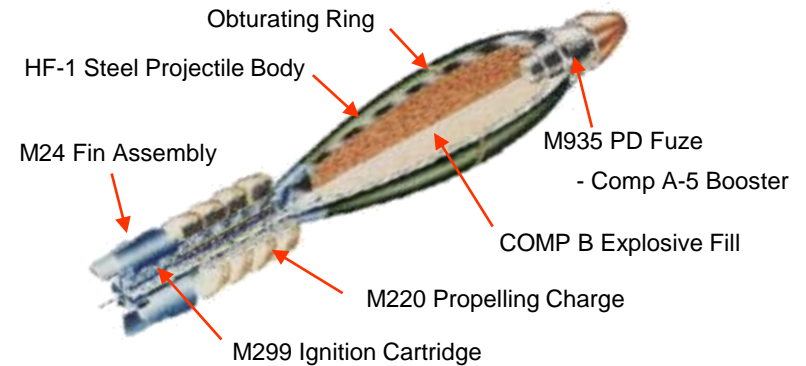
Item Nomenclature

Cartridge, 81mm: HE, M889A2/M821A2



Item Nomenclature

Cartridge, 81mm: HE, M889A1 (C869)



81mm HE Baseline IM Performance

IM Test	FCO	SCO	BI	FI	SD	SCJI
Passing Criteria	V	V	V	V	III	III
81mm (Comp-B)	III	I	IV	I	I	Fail

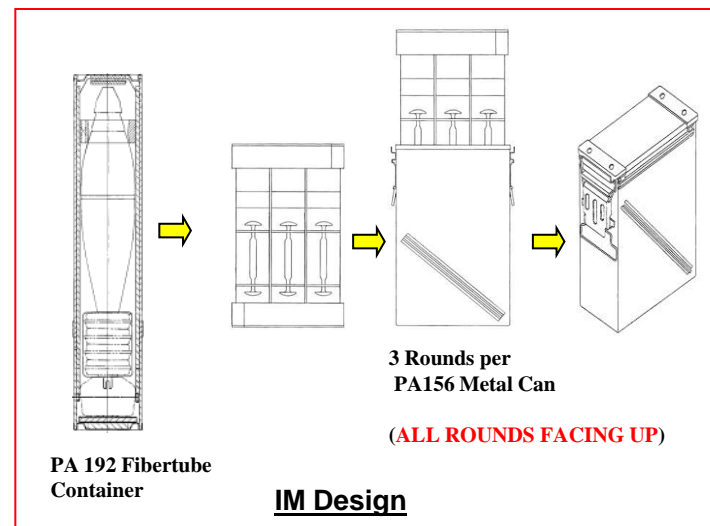
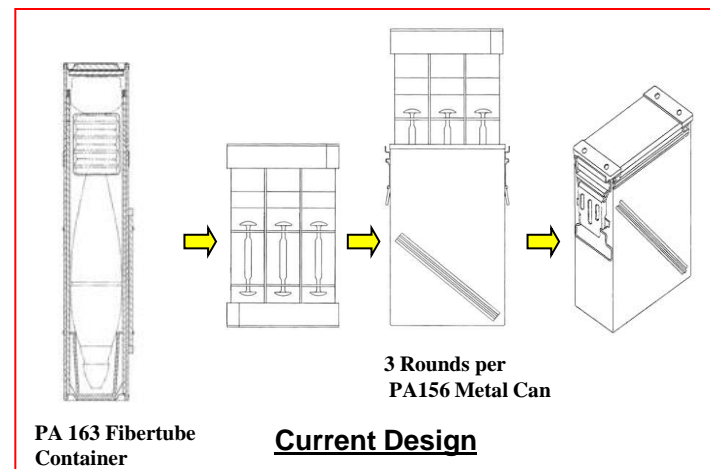
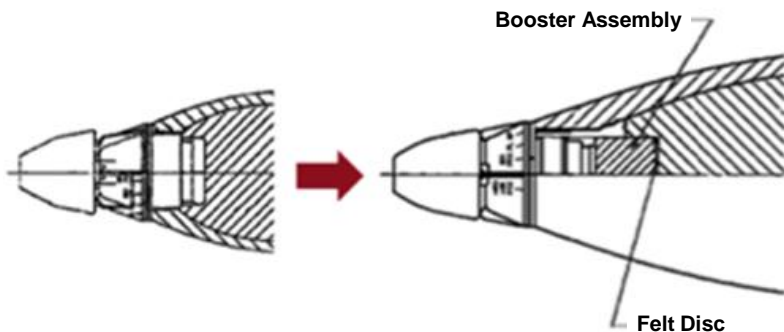
Reactions:

VI No Sustained Reaction	V Burn	IV Deflagration	III Explosion	II Partial Detonation	I Detonation
-----------------------------	-----------	--------------------	------------------	--------------------------	-----------------



81mm IM Path Forward

- M734A1/M783 Fuze (M821A2 & M889A2):
 - Maintain current PBXN-5 lead and booster
- M935 Fuze (M889A1):
 - Replace RDX lead with PBXN-5
 - Replace Comp A-5 booster with PBXW-14
 - Implement scored booster cup
- Implement PBXW-14 auxiliary booster
- Implement plastic fuze thread insert
- Adopt IMX-104 main charge.
- Packaging:
 - Replace fiber tube conical support with ring
 - Maintain current metal can (PA 156)
 - Package all rounds nose up





IM Testing on M821A2 cartridges utilizing IM fill performed in FY09:

IM Test	FCO		SCO		BI		FI		SD	SCJI	
	T	L	T	L	T	L	T	L		T	L
Passing Criteria	V		V		V		V		III	III	
81mm Baseline (Comp-B)	III		I		IV		I		Fail	Fail	
	T	L	T	L	T	L	T	L		T	L
81mm IM Enhanced (M821A2/M889A2)	V	V	V	V	IV	V	I	IV	Pass	Fail	
81mm IM Enhanced (M889A1)	V	V	V	V	IV	V	I	V	Pass	Fail	

Reactions:

VI No Sustained Reaction	V Burn	IV Deflagration	III Explosion	II Partial Detonation	I Detonation
------------------------------------	------------------	---------------------------	-------------------------	---------------------------------	------------------------



Engineering Phase		
Task	Status	Completion Date
M783/M734A1 Fuze Reliability	Complete	Mar 2011
IMX-104 EMQB Qualification	Complete	June 2011
PBXW-14 EMQB Qualification	Complete	Sep 2011
M935 Fuze Reliability	Ongoing	May 2012

Systems Integration Phase				
Task	60mm		81mm	
	Status	Completion Date	Status	Completion Date
IM/FHC Testing	Ongoing	May 2012	Complete	Jun 2011
Arena Testing	Scheduled	Jun 2012	Complete	Apr 2012
PQT	Ongoing	Aug 2012	Ongoing	Jun 2012
ECP	Scheduled	Nov 2012	Scheduled	Sep 2012
Production	Scheduled	Oct 2014	Scheduled	Oct 2014



- IM Strategy
 - Current IM Technology:
 - Fuze Venting
 - Packaging Improvements
 - CLIMEx downselect
 - IMX-104
 - PBXW-14
- Significant IM performance improvement demonstrated
- Initiation Reliability vs. IM
 - Supplemental Charges
- Incremental IM Approach
 - Further development required for full IM compliance
 - SCJI

No “new” rounds.
Minimal unit cost
impact



Questions?

Contact Info:

Nickolas Baldwin
Building 94 South, 2nd Floor
Picatinny Arsenal, NJ 07806-5000
973-724-8642
nickolas.baldwin@us.army.mil

Co-Contributors:

Leila Zunino
Phil Samuels
Dan Zaloga
Keyur Patel
Erik Wrobel

M720A1/M768 (M783/M734A1 Fuze):

- Instrumented Detonation Testing
 - 2 rounds @ Ambient
 - IMX-104 main fill
 - PBXN-5 fuze booster
 - Plastic fuze adapter
 - HF-1 shell body



Shot # 1			
Pin	Time (μs)	Pins	Det. Vel. (km/s)
1	t_0	1-2	6.48
2	3.9222	2-3	6.75
3	7.687	3-4	7.39
4	11.1248	4-5	7.24
5	14.6342		

Shot # 2			
Pin	Time (μs)	Pins	Det. Vel. (km/s)
1	t_0	1-2	5.25
2	4.835	2-3	5.03
3	9.8804	3-4	7.07
4	13.4734	4-5	7.71
5	16.7698		



60mm Initiation Reliability

