U.S. Army Research, Development and Engineering Command

TECHNOLOGY DRIVEN. WARFIGHTER FOCUSED.

U.S. Forces Light and Medium Mortar Ammunition Insensitive Munitions Path

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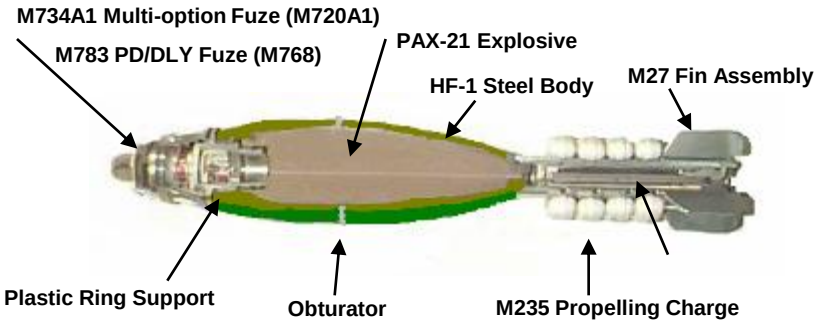
Insensitive Munitions (IM) Program Requirements

- **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.

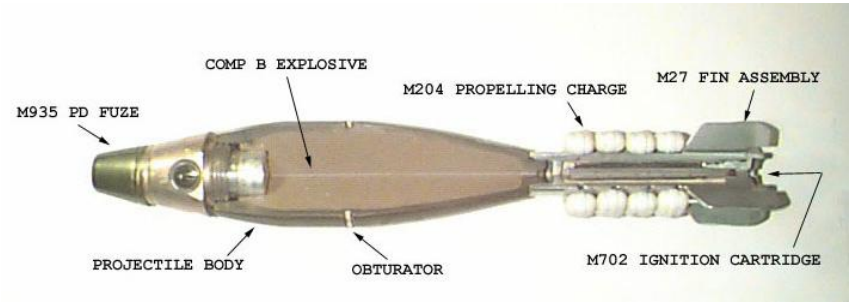
60mm Baseline Configurations

Item Nomenclature
Cartridge, 60mm: HE, M720A1/M768



TC: OCT 01 **MR: APR 06**

Item Nomenclature
Cartridge, 60mm: HE, M888



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

M720A1/M768 Baseline IM Performance

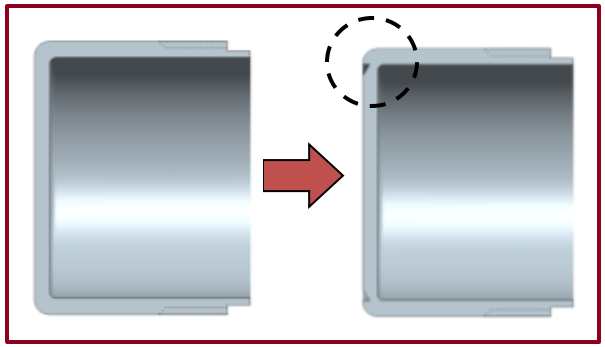
IM Test	FCO	SCO	BI	FI	SD	SCJI
Passing Criteria	V	V	V	V	III	III
M720 (Baseline)	II	III	V	III	I	I
M720A1/M768	V	II V	V	III	I	I

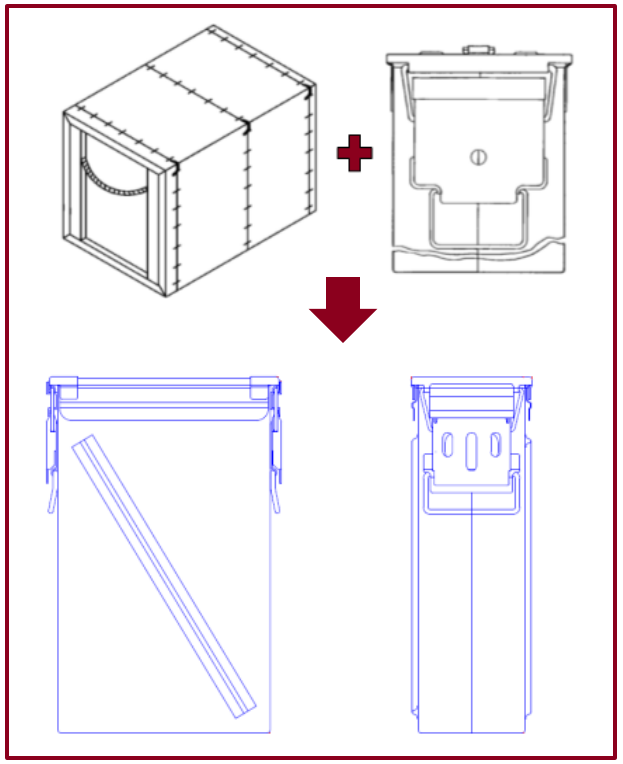
Reactions: VI No Sustained Reaction | V Burn | IV Deflagration | III Explosion | II Partial Detonation | I Detonation

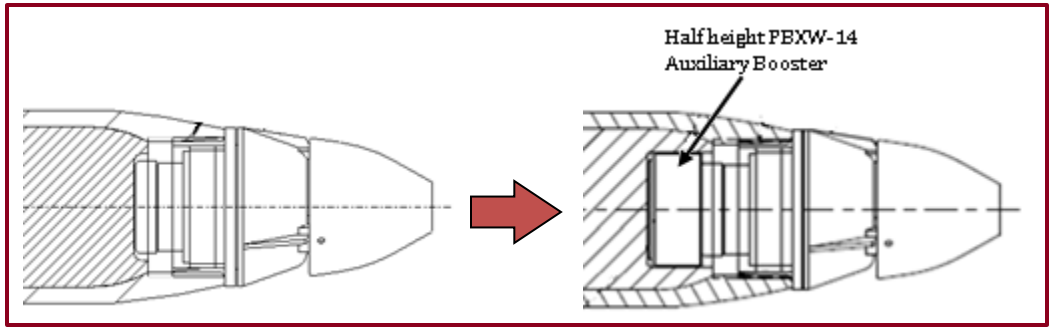
60mm IM Enhanced Design Strategy

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 supplemental charge
- Adopt IMX-104 main charge.
- Packaging:
  - Maintain current longer fiber tube (PA189)
  - New metal can over pack (PA191).
  - Package all rounds nose up



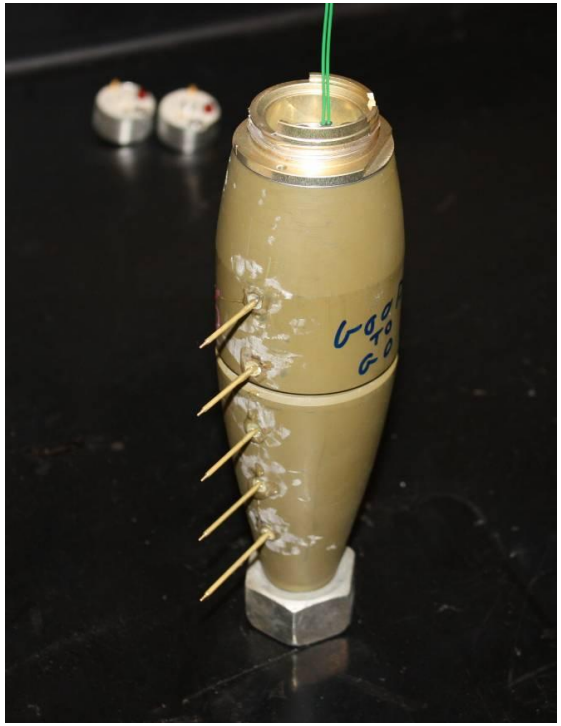




60mm Fuze Reliability Testing

M720A1/M768 (M783/M734A1 Fuze):

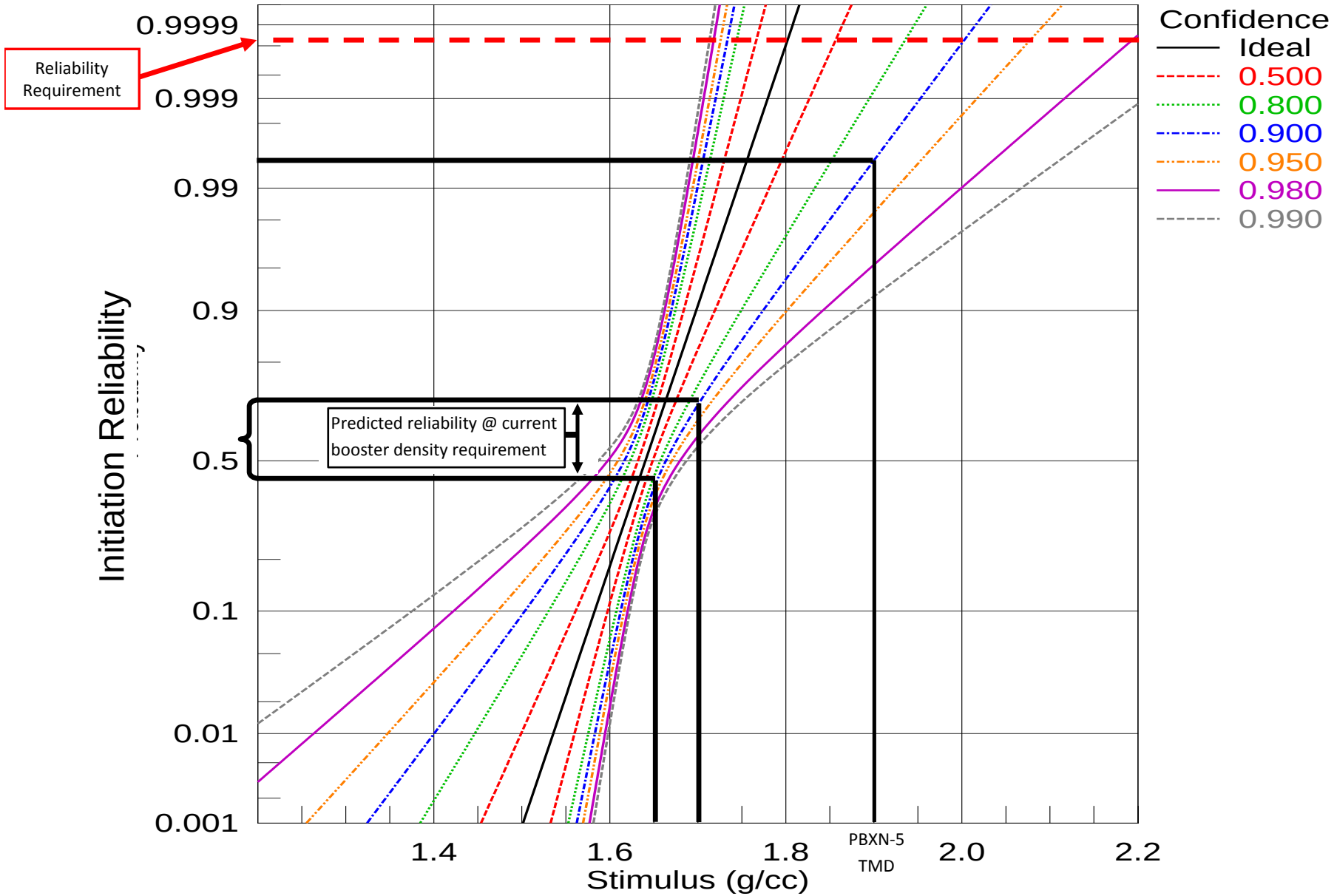
- Instrumented Detonation Testing
  - –2 rounds @ Ambient
    - •IMX-104 main fill
    - •PBXN-5 fuze booster
    - •Plastic fuze adapter
    - •HF-1 shell body



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		

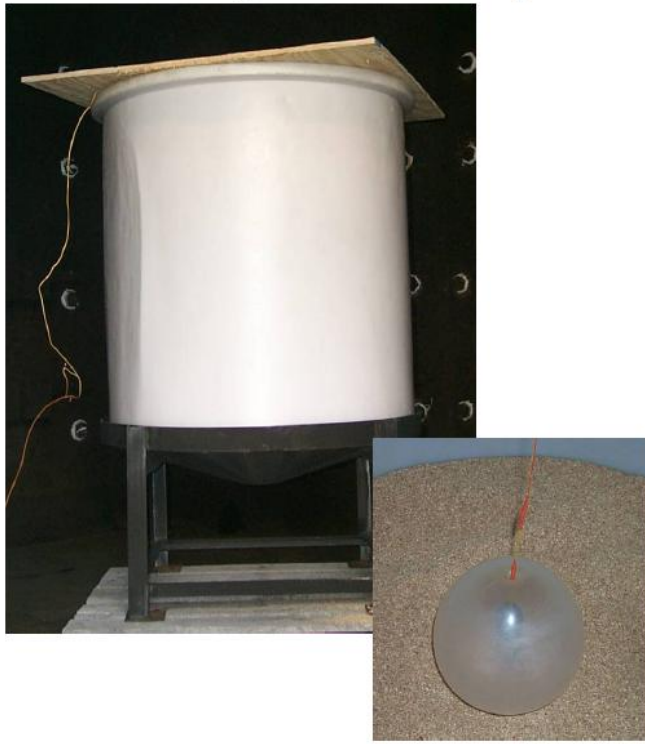
Shot # 2			
Pin	Time (µs)	Pins	Det. Vel. (km/s)
1	t_0	1-2	5.25
2	4.835	2-3	5.03
3	9.8804	3-4	7.07
4	13.4734	4-5	7.71
5	16.7698		

60mm Initiation Reliability



IM Fragmentation Performance

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



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Normalized Lethal Area

	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)
Personnel - AB	500	1.00	1.11	1.04	0.95
	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

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Normalized Lethal Area

	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)
Materiel - AB	500	1.00	0.86	0.98	1.03
	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

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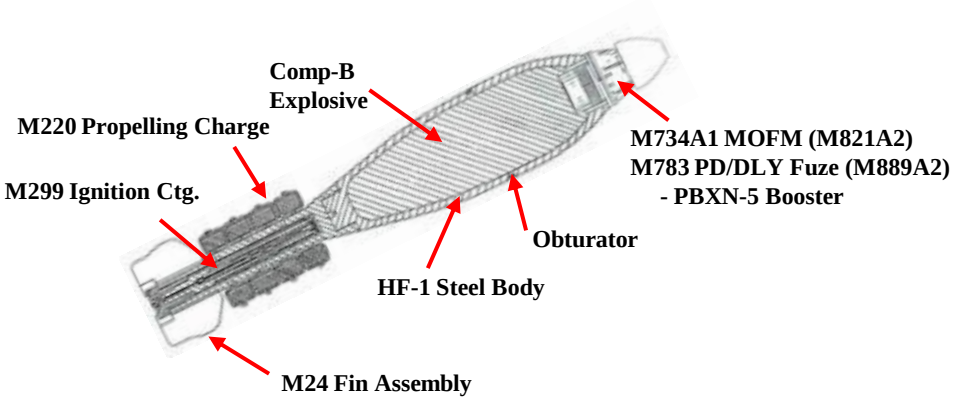
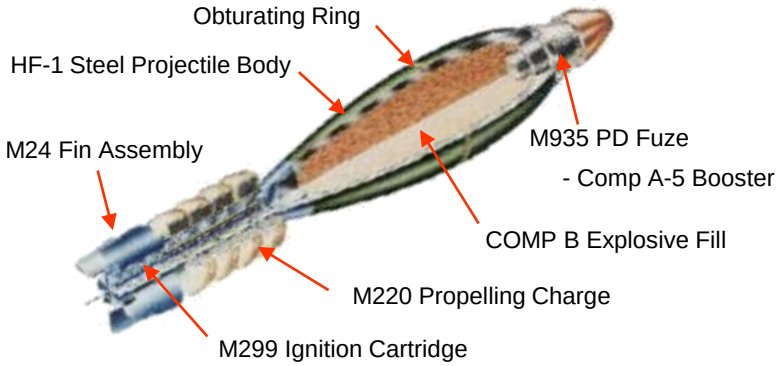
81mm Baseline Configuration

Item Nomenclature
Cartridge, 81mm: HE, M889A2/M821A2



Item Nomenclature
Cartridge, 81mm: HE, M889A1 (C869)



Baseline IM Testing on M821A2 mortars:

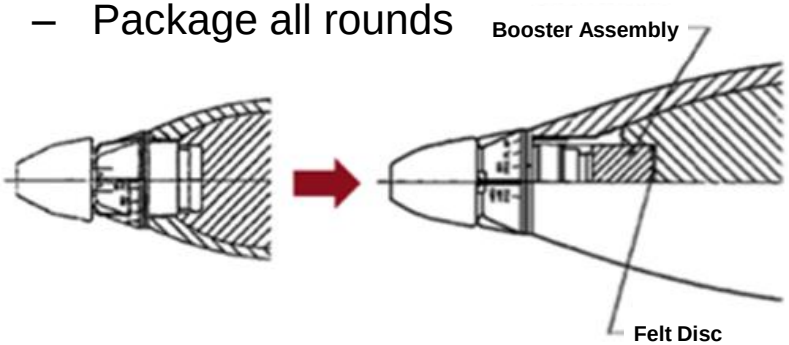
IM Test	FCO	SCO	BI	FI	SD	SCJI
Passing Criteria	V	V	V	V	III	III
81mm Baseline (Comp-B)	III	I	IV	I	I	Fail

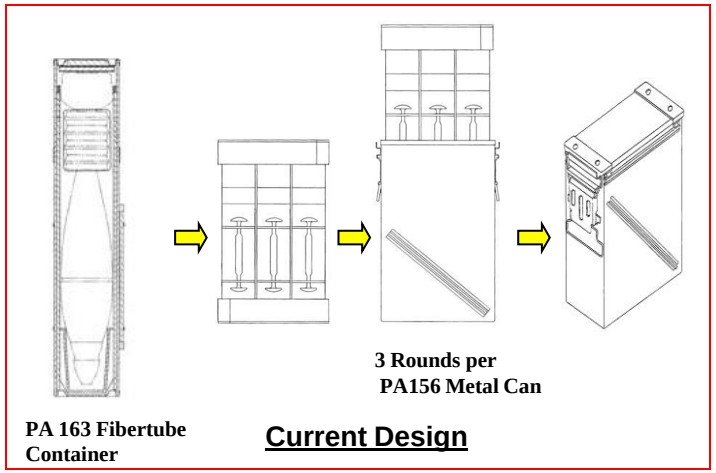
Reactions: VI No Sustained Reaction | V Burn | IV Deflagration | III Explosion | II Partial Detonation | I Detonation

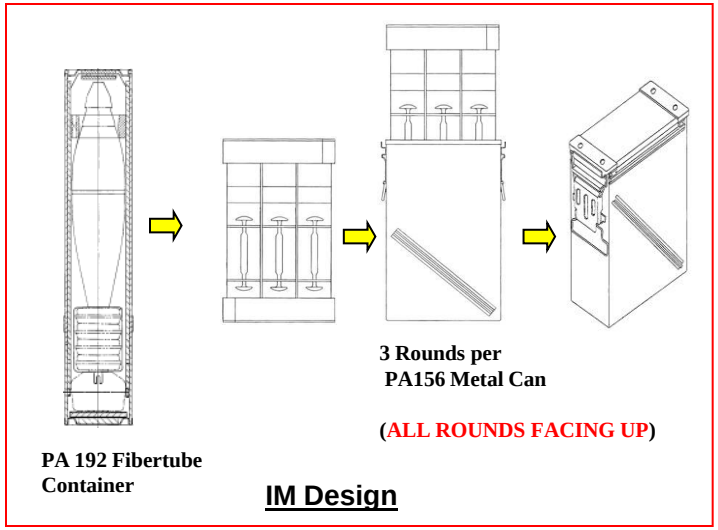
81mm IM Design

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 supplemental charge
- Implement plastic fuze thread insert
- Adopt IMX-104 main charge.
- Packaging:
  - Replace current fiber tube conical support with more robust ring design
  - Maintain current metal can (PA 156)
  - Package all rounds







81mm IM Performance Progression

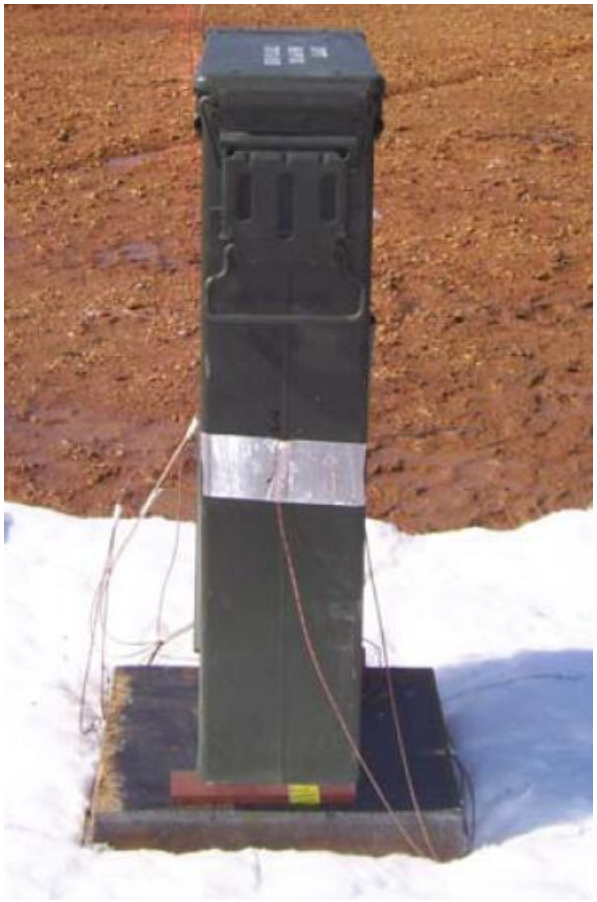
IM Testing on M821A2 cartridges utilizing IM fill performed in FY09:

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

* - Unofficial scores. Pending IM Board review

81mm Formal SCO Test

- Full-up M821A2/M889A2 configuration
- Type V reaction
- Highly effective fuze venting



Fast Cookoff

Type V reaction
Highly effective fuze venting

Bullet Impact (.50 cal)

Summary

- IM Strategy
  - Current IM Technology:
    - Fuze Venting
    - Packaging Improvements
  - CLIMEx downselect
    - IMX-104
  - PBXW-14

No “new” rounds. Minimal unit cost impact

- Significant IM performance improvement demonstrated
- Initiation Reliability vs. IM
  - Supplemental Charges
- Incremental IM Approach
  - Further development required for full IM compliance
    - SCJI

Questions?

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