RHEINMETALL
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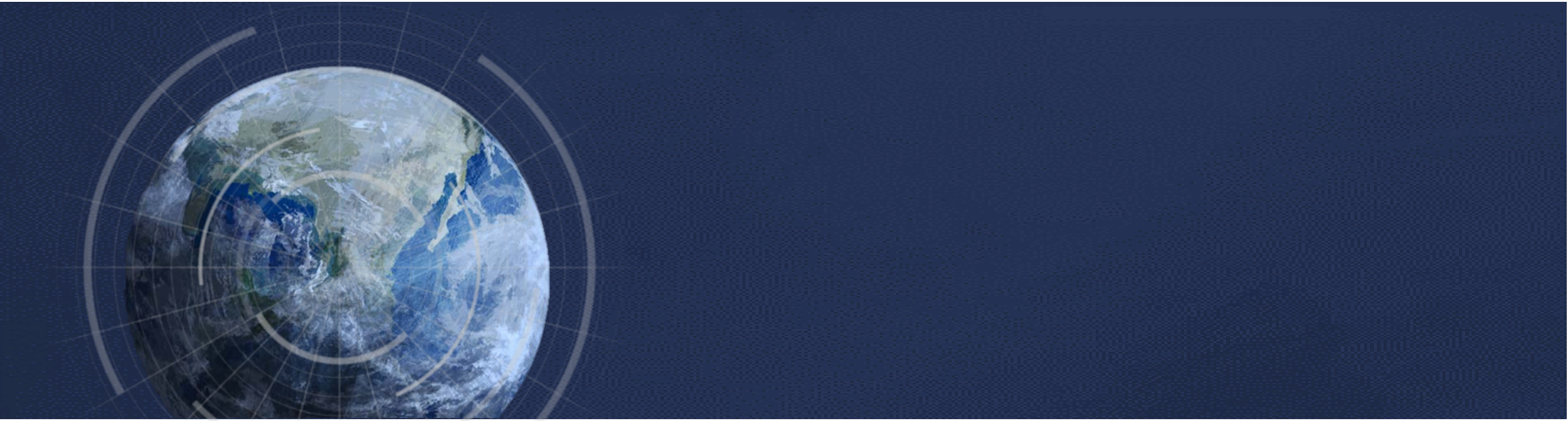


RHEINMETALL DENEL MUNITION RF (PTY) LTD

IM and Fragmentation Assessment of 81 mm Mortar Bombs Filled with Insensitive Melt-Cast Explosive Formulations

Jackie Sibeko, Christo du Toit and Deon van Zyl*

Overview

Introduction

Melt-cast Filling Facility

IM Characterisation Assessment

- FH
- SH
- BI
- FI
- SR
- SCJI

Fragmentation Assessment

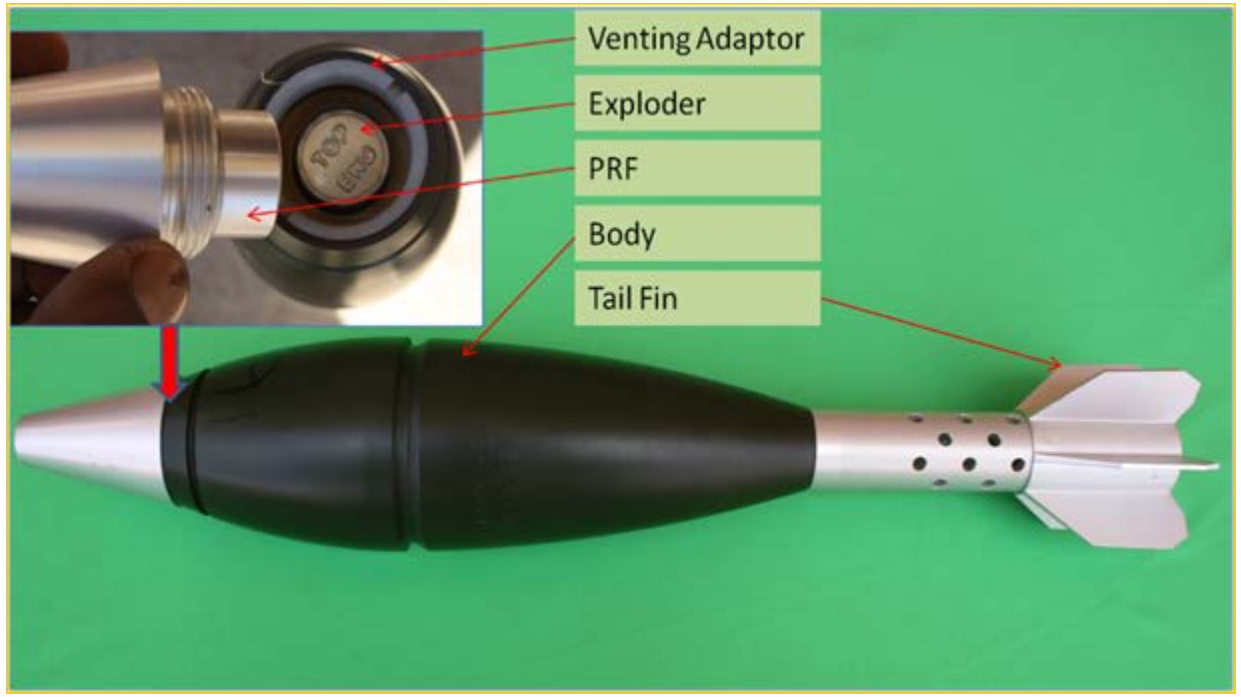
Introduction

Test Vehicle: Qualified 81mm XM1134 IHE mortar bomb.

Compatible with L16 mortar systems.

Melt-cast Explosive formulations:

- Ontalite 50/50
- GUNTOL
- MCX-6002



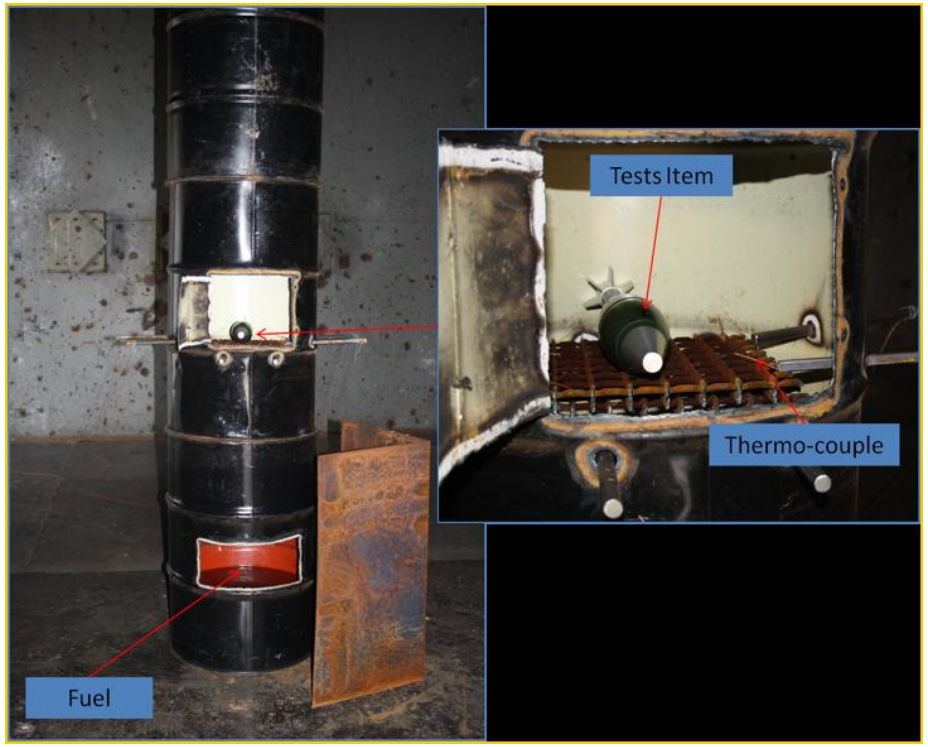
Melt-Cast Filling Facility

Existing and Mature Filling Process for TNT.

IM Characterisation Assessment

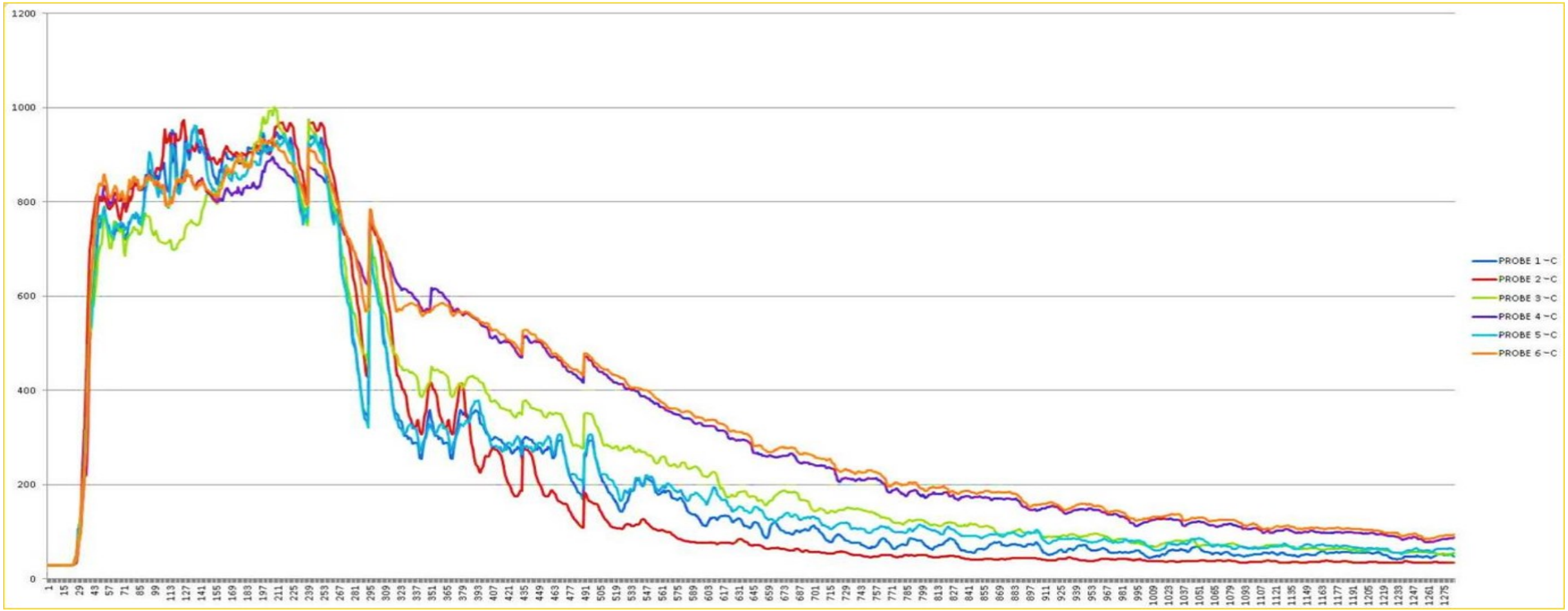
Fast Heating Tests (Fuel fire)

- Tested item bare (without logistical packaging).



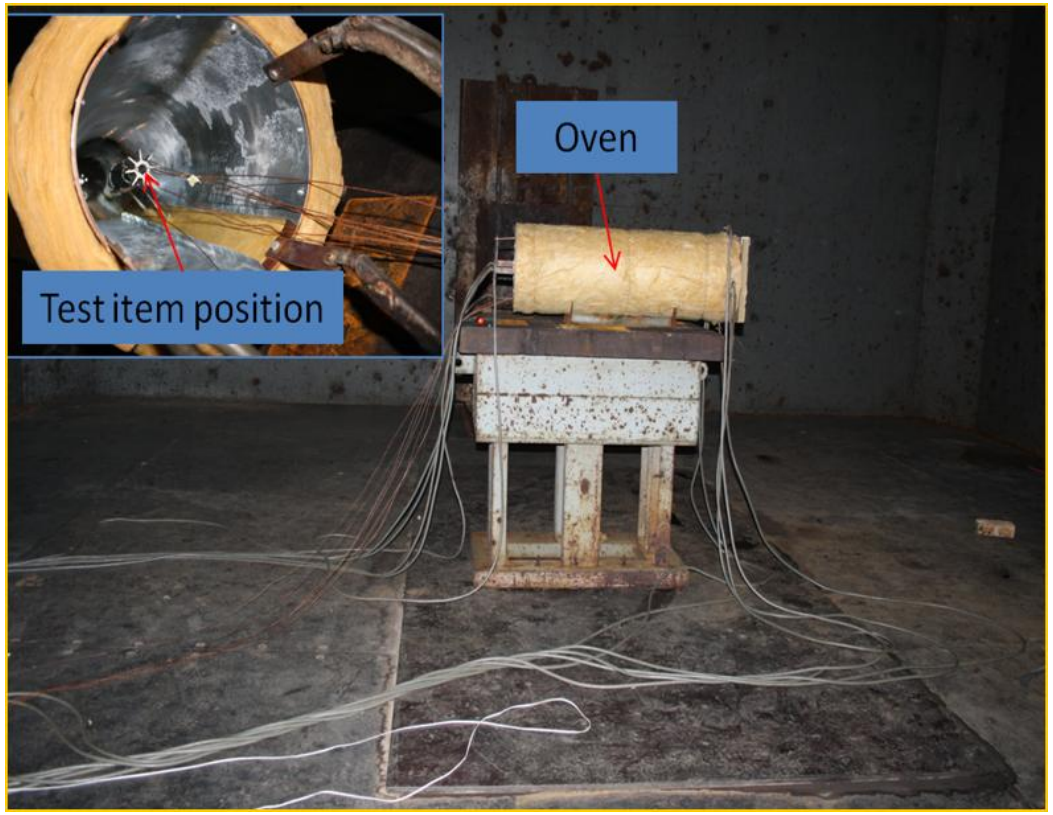
IM Characterisation Assessment

Fast Heating Results



IM Characterisation Assessment

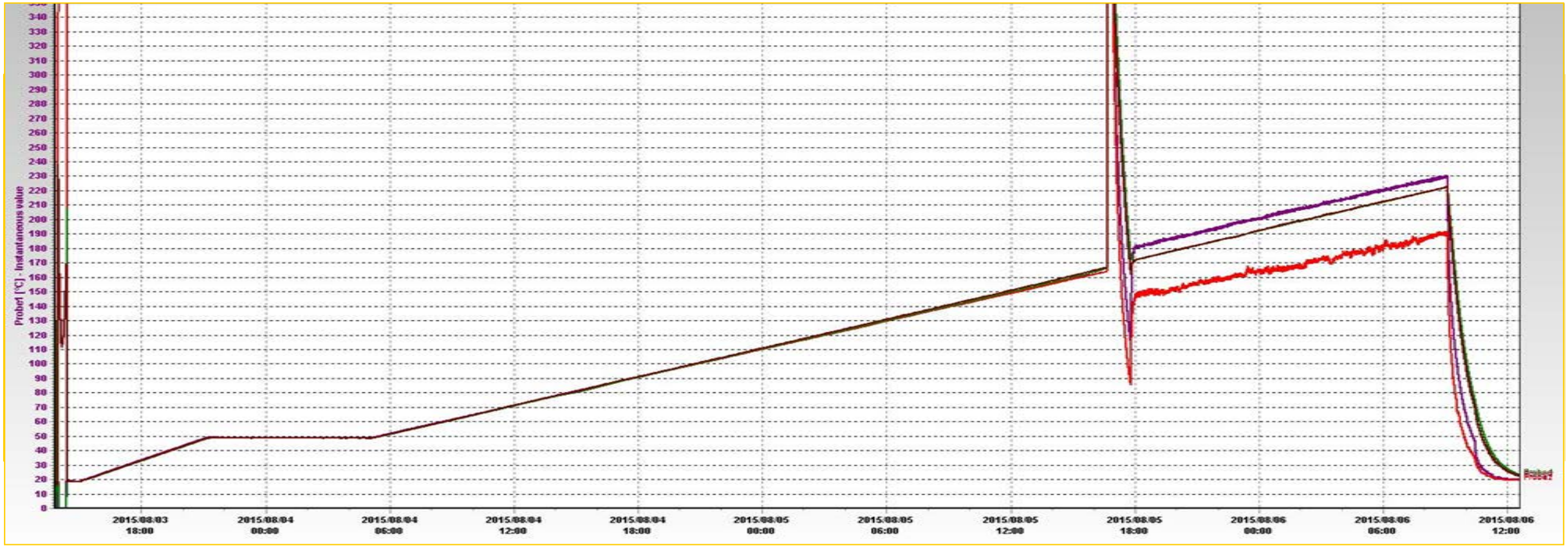
Slow Heating Tests



IM Characterisation Assessment

Slow Heating Results

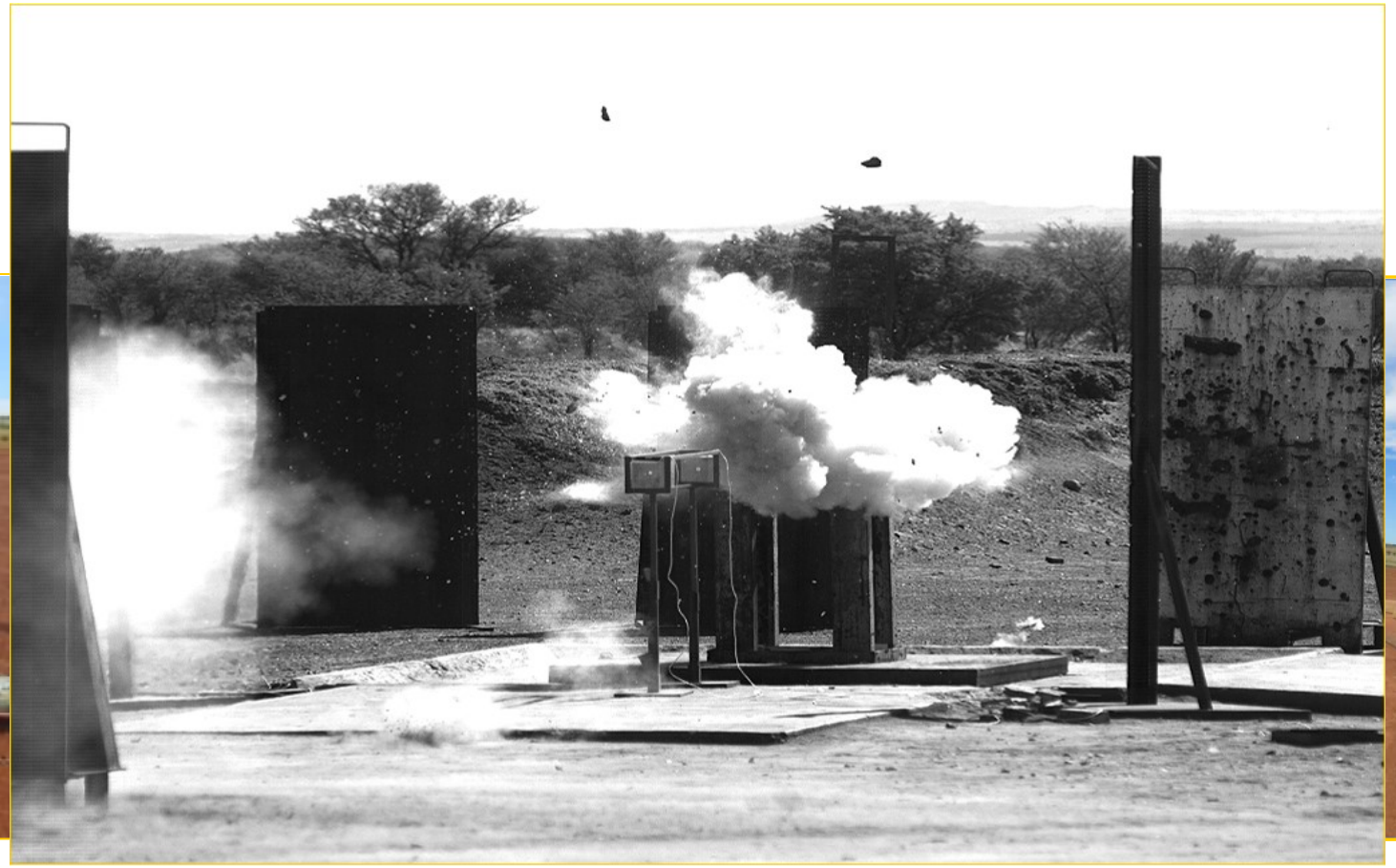
- Reaction Type V (Burning)



IM Characterisation Assessment

Bullet Impact Tests (small arms attack)

- 12.7 mm AP Round
- Bullet Velocity 850±20 m/s
- Browning Machine Gun

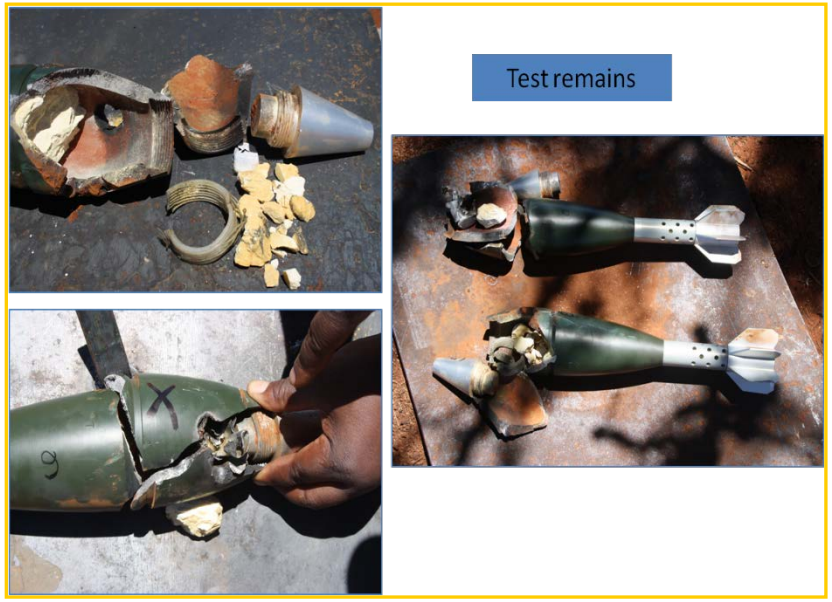


IM Characterisation Assessment

Bullet Impact Results

- Reaction Type IV (Deflagration)

Ontalite 50/50



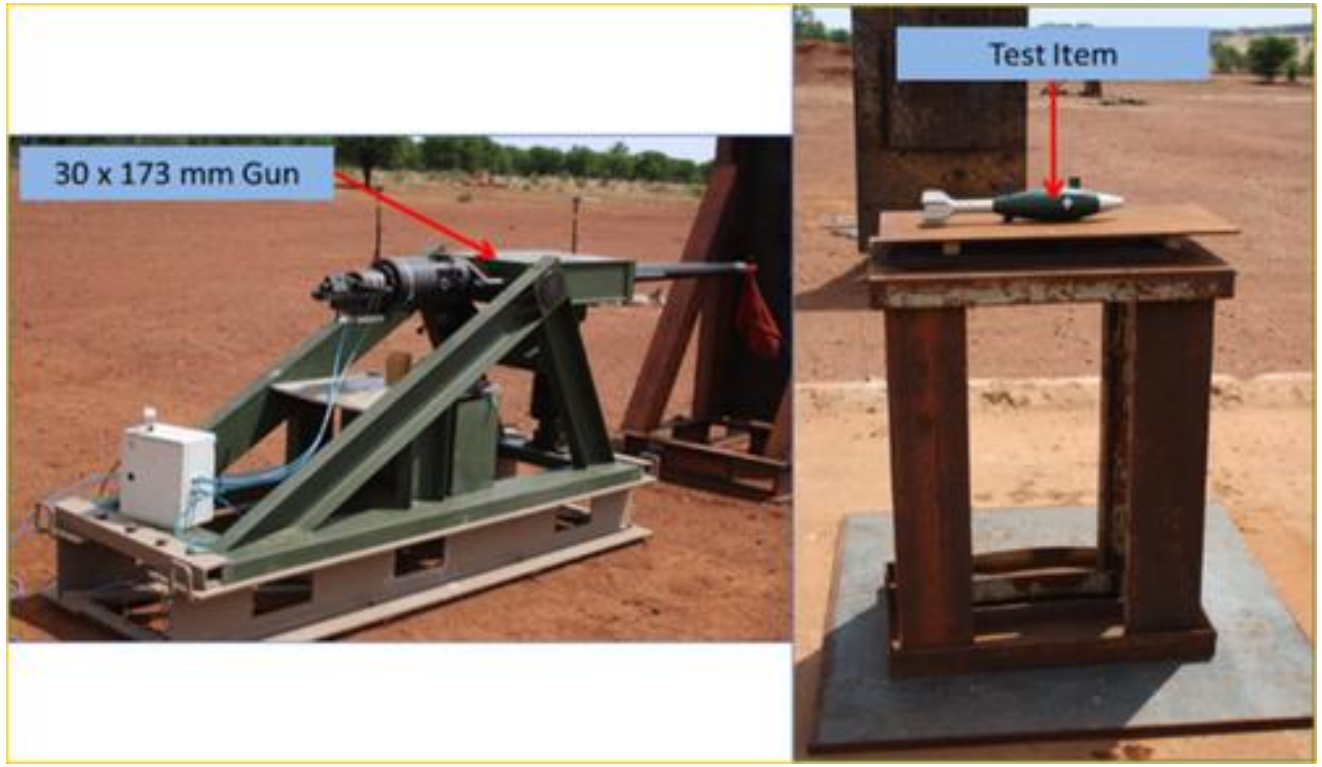
GUNTOL

MCX-6002

IM Characterisation Assessment

Fragment Impact

- Fragment imbedded in a sabot.
- Conical shaped 18.6 g, 14.3 mm diameter, 15.56 mm total length, 20° tip angle.
- Velocity = 1830±60 m/s.



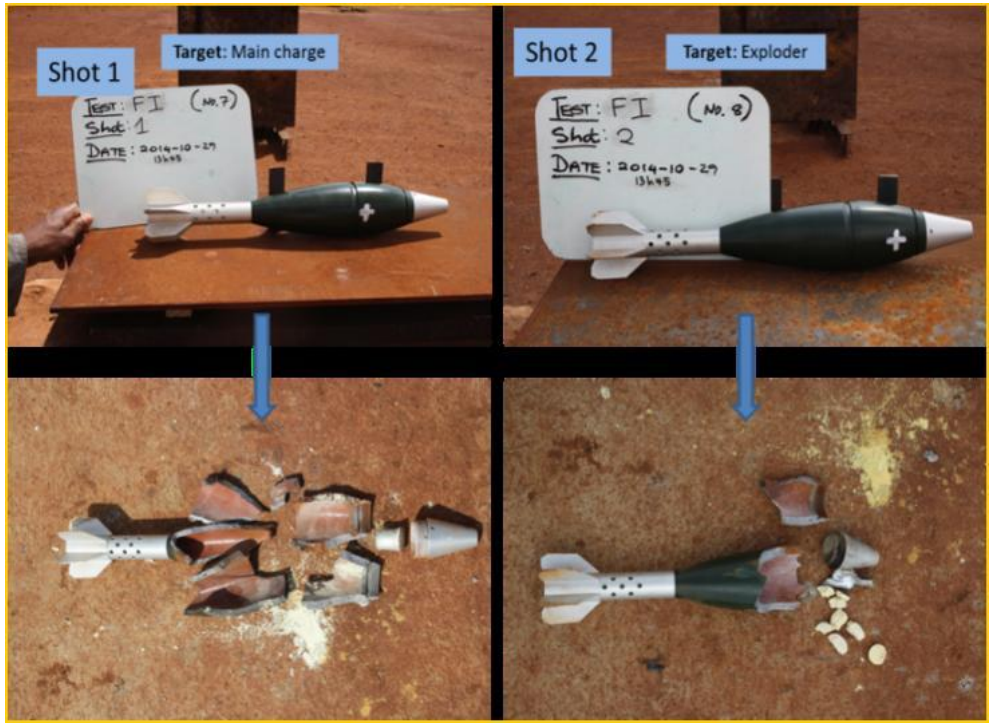
IM Characterisation Assessment

Fragment Impact Results

- Reaction Type IV (Deflagration)

Ontalite 50/50

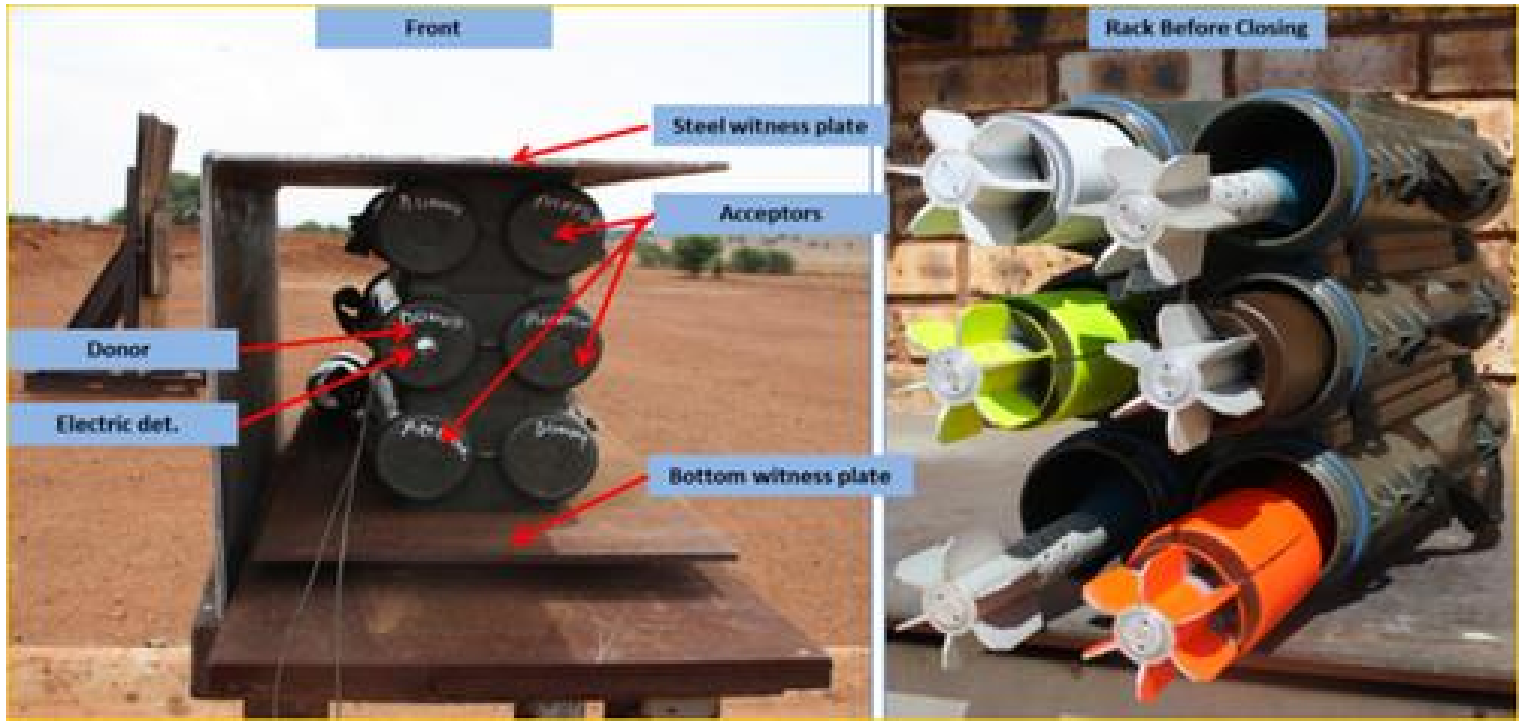
GUNTOL



IM Characterisation Assessment

Sympathetic Reaction Test

- Donors coloured brightly & Differently.
- Inert bombs coloured blue, included for reference purposes.
- Sceptre Logistical Packaging – six-pack container.

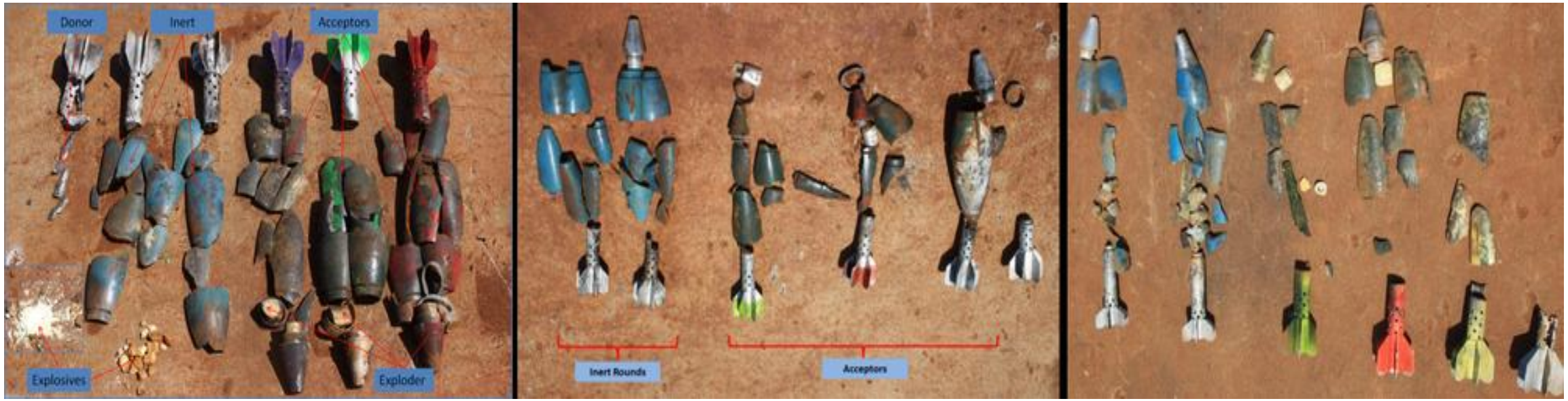


IM Characterisation Assessment

Sympathetic Reaction Results

- Reaction Type IV

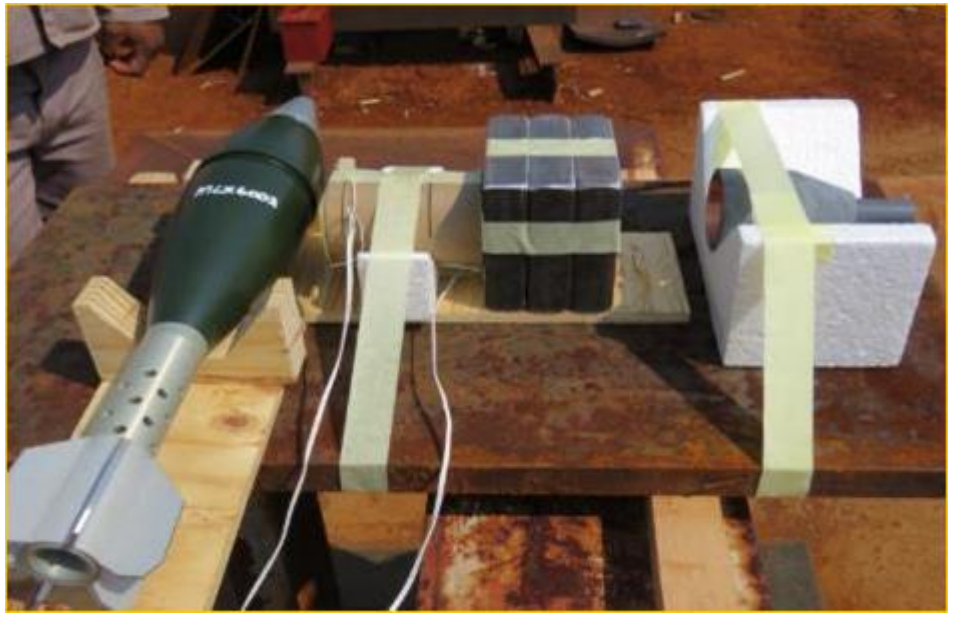
Ontalite 50/50 | GUNTOL | MCX-6002



IM Characterisation Assessment

Shaped Charge Jet Impact

- 57mm SC
- Quantification of Sensitivity –Determine Reaction Threshold.
- Varying a V^2d until reaction III was obtained.



Characteristic	Value	
	Velocity (mm/µs)	Particle Diameter (mm)
Leading Particle	9.15 – 9.33	4.7 – 5.5
Average Particle Diameter per Velocity Interval after Particulation	Velocity Interval	Average Particle Diameter (mm)
	8 – 9	2.6
	7 – 8	2.5
	6 – 7	2.5
	5 – 6	2.6
	4 – 5	2.8
	3 – 4	3.0
	2 – 3	3.1
Average Breakup Time per Velocity Interval		Average Breakup Time (µs)
	8 – 9	89
	7 – 8	83
	6 – 7	89
	5 – 6	112
	4 – 5	111
	3 – 4	127
	2 – 3	123
	Value	
Standoff (Charge – Item)	100 - 224	
Position of Virtual Origin from Liner Base	Typically 30 mm	
Penetration Capability	150 – 350 mm	

IM Characterisation Assessment

Shaped Charge Results

Formulation	Test Number	Conditioning armour (mm)	V^2d ($mm^3/\mu s^2$)	Reaction Type
RXHT 80 (REF.)	1	50	100	II
	2	125	50	V
	3	75	75	V
	4	60	→ 88	IV
MCX-6002	5	50	100	II
	6	75	→ 75	III
	7	125	50	IV
Ontalite 50/50	8	75	75	IV
	9	50	100	IV
	10	25	145	II
	11	35	→ 121	III
GUNTOL	12	0	662	II
	13	25	145	II
	14	50	→ 100	III
	15	75	75	IV
	16	100	59	V

IM Characterisation Assessment

IM Signature

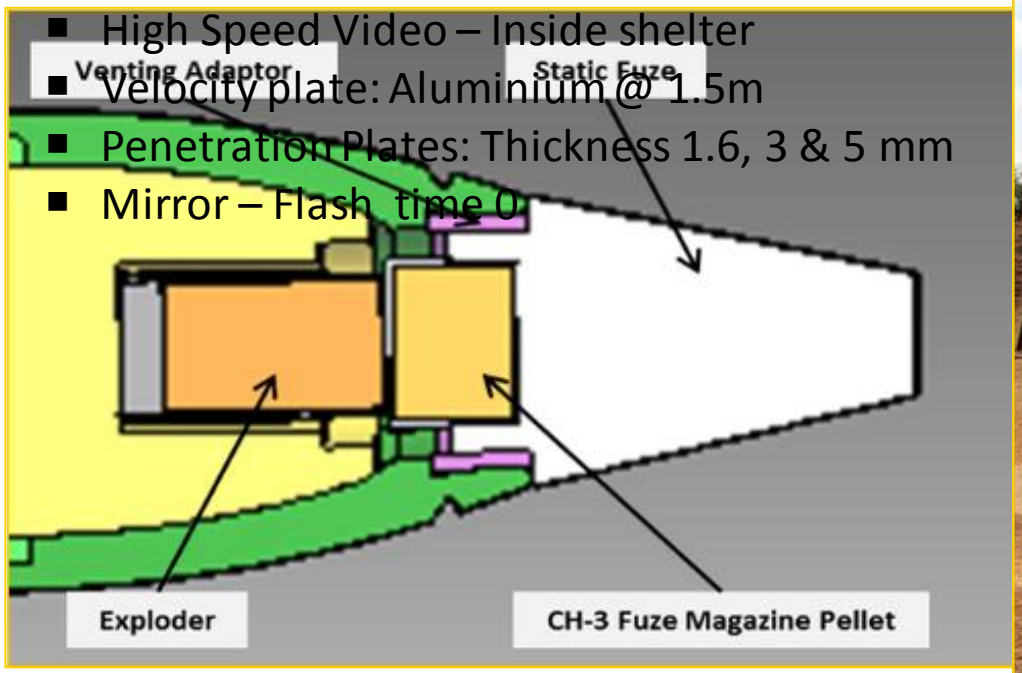
	FH	SH	BI	FI	SR	SCJI
STANAG 4439 REQUIREMENT	V	V	V	V	III	III
MCX-6002, PRF, 81mm Mortar Bomb XM1134	V	V	IV	TBD	IV	III*
GUNTOL, PRF, 81mm Mortar Bomb XM1134	V / IV	V	IV	IV	IV	III**
Ontalite 50/50, PRF, 81mm Mortar Bomb XM1134	V	V	IV	IV	IV	III***
RXHT-80, PD Fuze, 81mm Mortar Bomb XM1134	IV	V	IV	IV	IV	III****
RXHT-80, MOF Fuze, 81mm Mortar Bomb XM1134	IV	IV	IV	IV	IV	III****

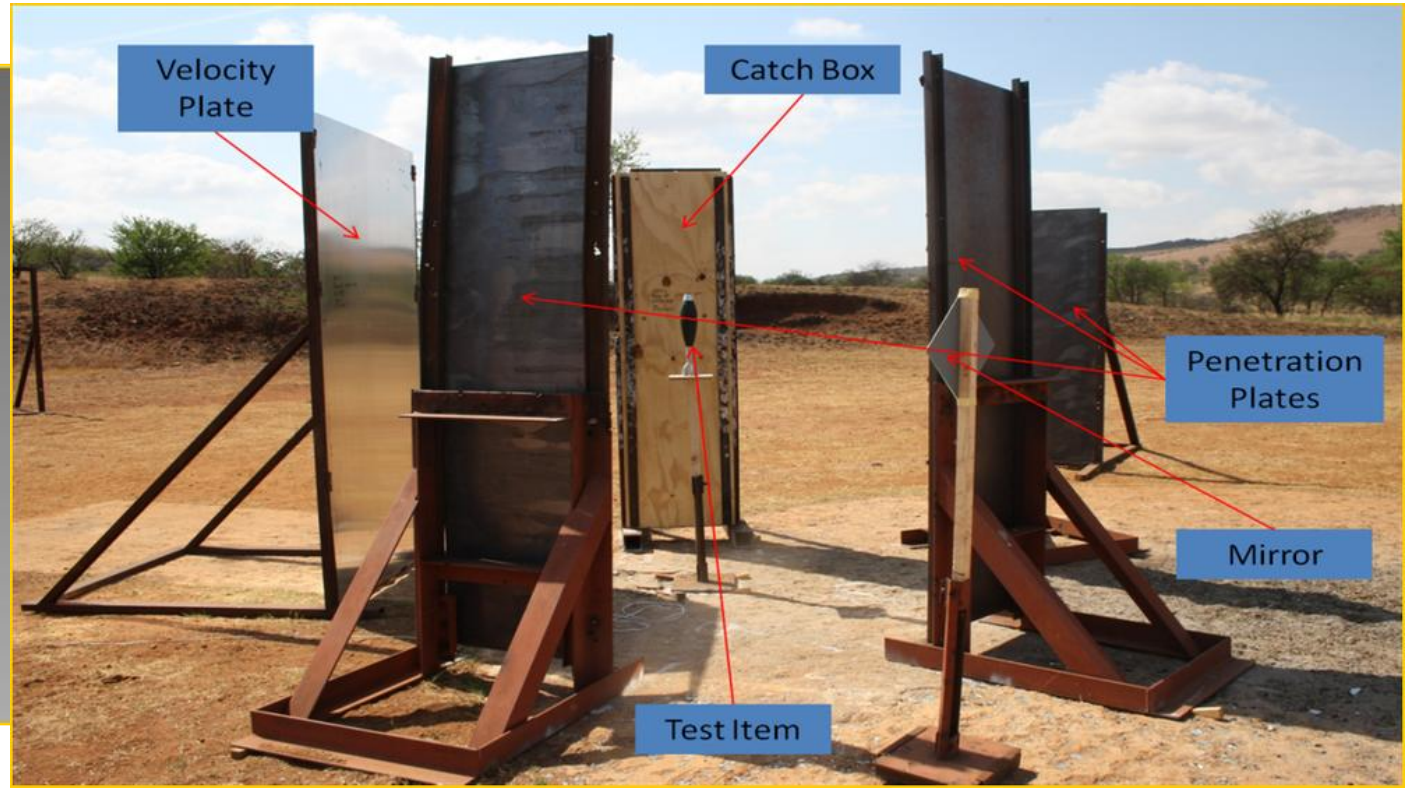
Note: 81 mm RXHT 80 fuzed mortar bombs were tested in their (sceptre) logistical packaging, except for SCJI.
* $V^2d = 74.6\ mm^3/\mu s^2$,
** $V^2d = 100\ mm^3/\mu s^2$ and
*** $V^2d = 121.31\ mm^3/\mu s^2$
**** $V^2d = 88\ mm^3/\mu s^2$

Fragmentation Assessment

Configuration & Test Layout

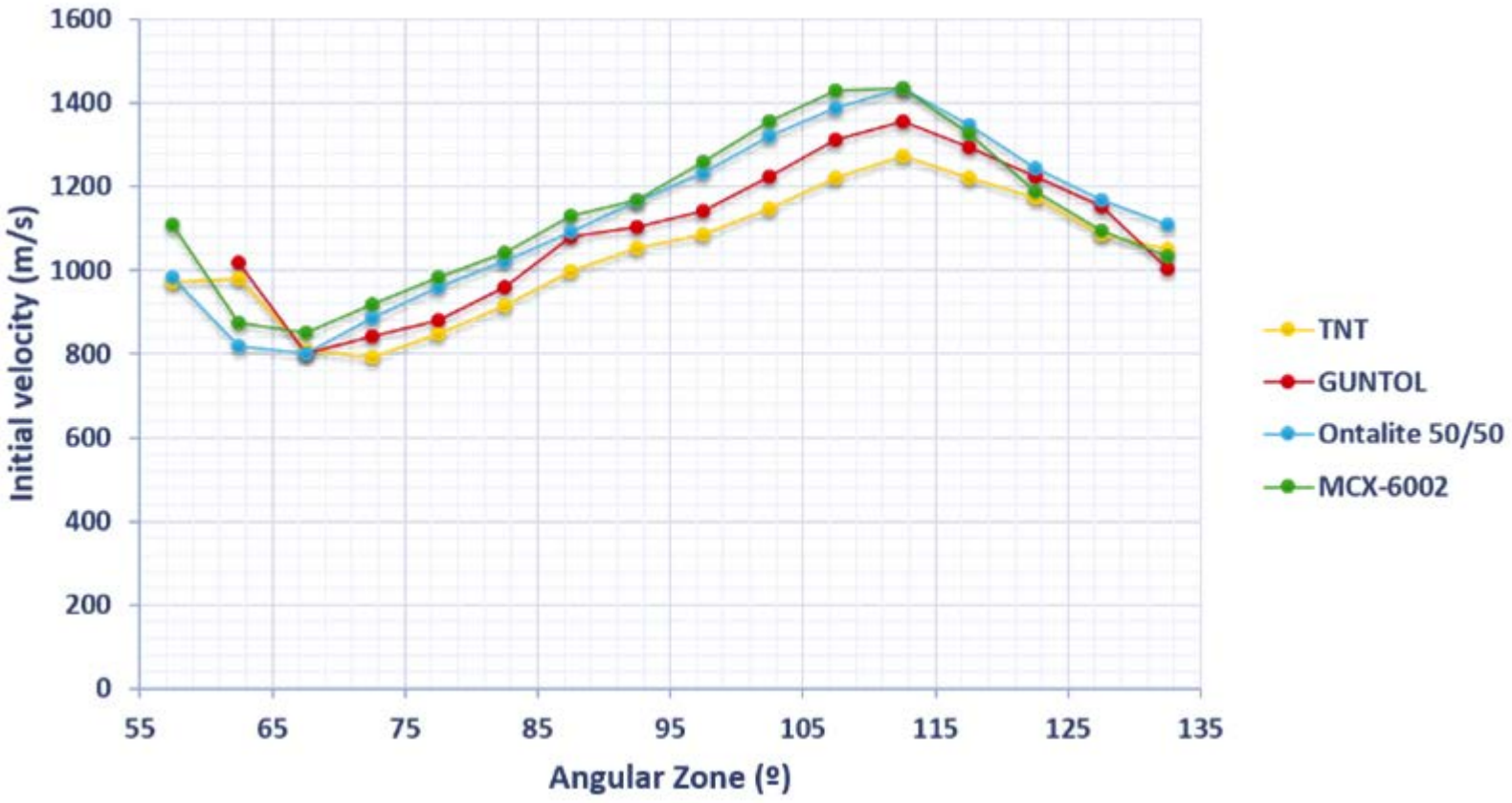
- High Speed Video – Inside shelter
- Velocity plate: Aluminium @ 1.5m
- Penetration Plates: Thickness 1.6, 3 & 5 mm
- Mirror – Flash time 0





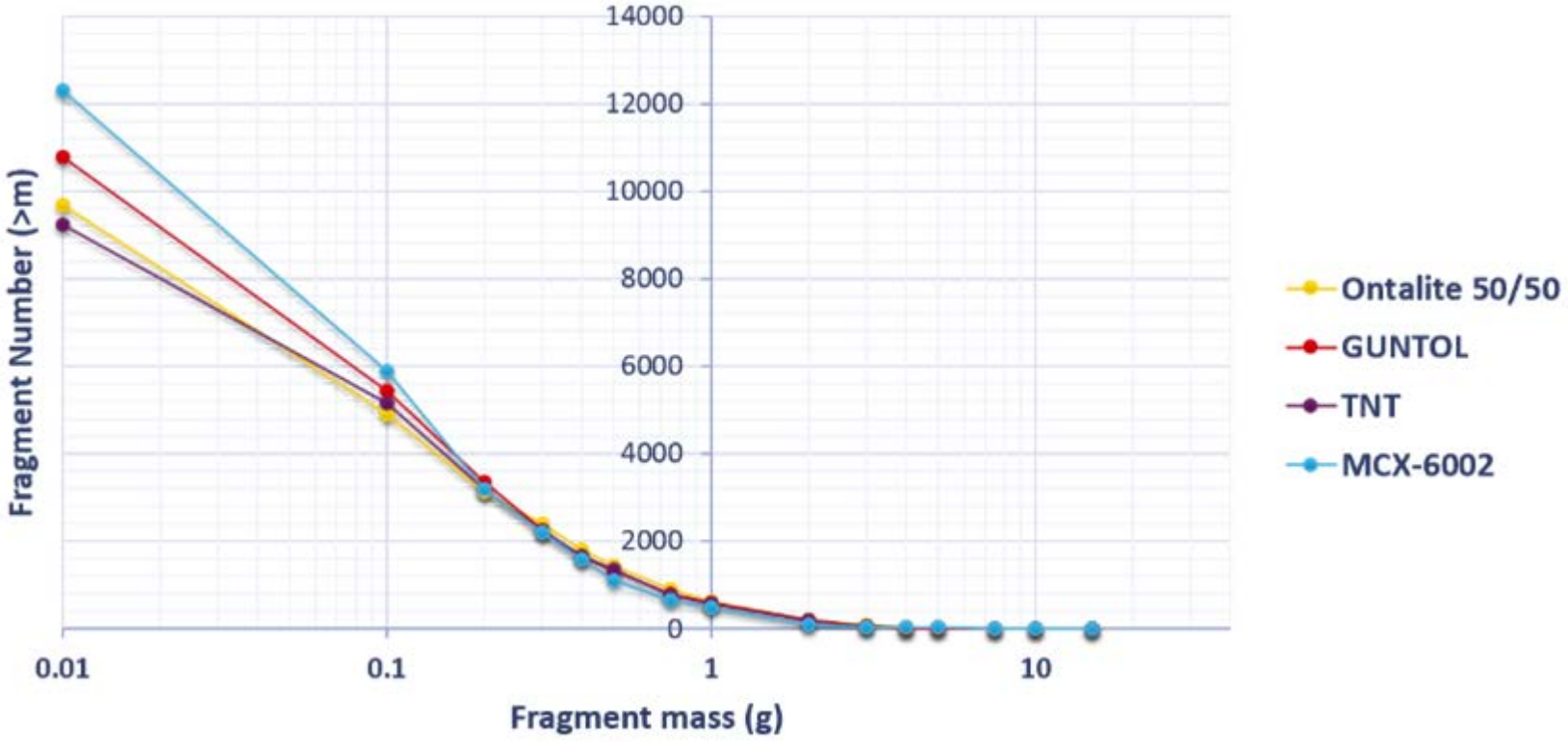
Fragmentation Assessment

Fragment average velocities



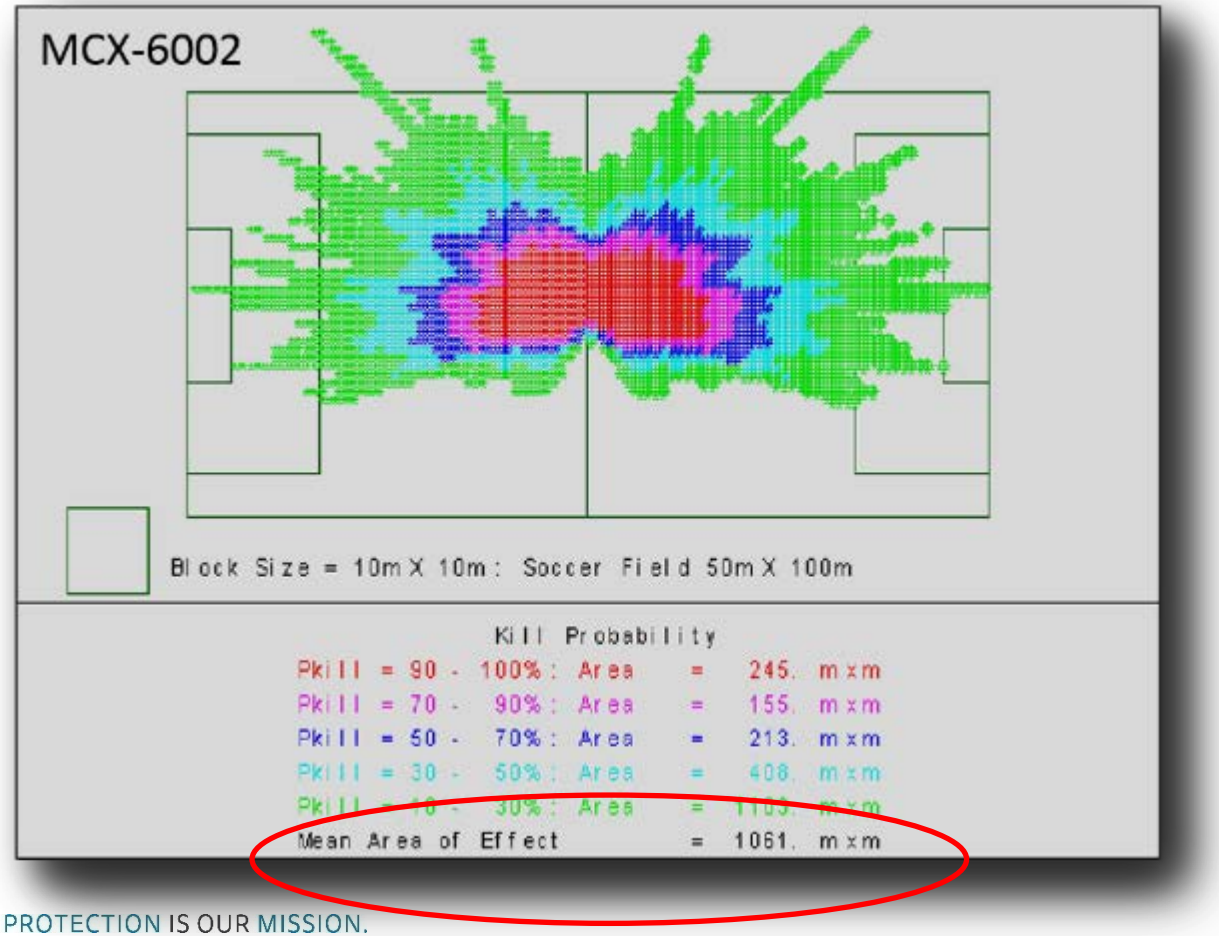
Fragmentation Assessment

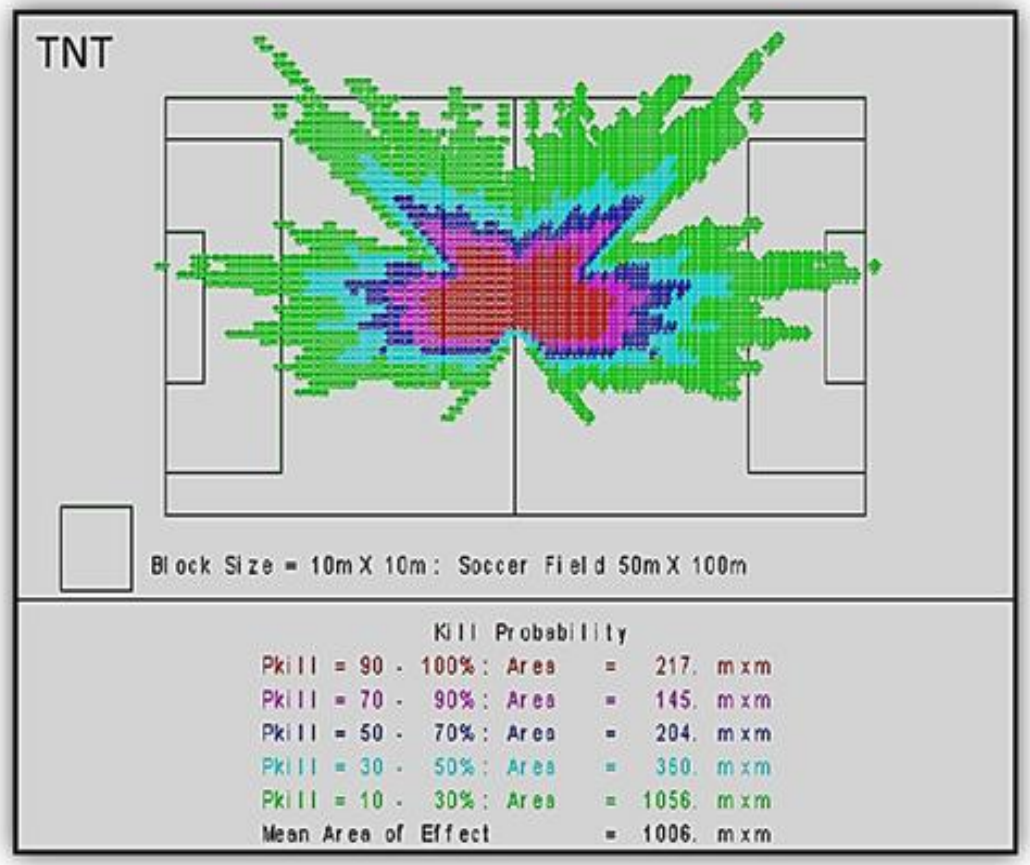
Cumulative Number Distribution



Fragmentation Assessment

Lethality Prediction (Sperrazza Model)





Conclusion

- **Lethality performance of IM melt-cast explosives variants studied compared well with TNT reference.**

Thank You.

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