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Munitions Safety Information Analysis Center

NIMIC
pilot MSIAC











New and Evolving Insensitive Munitions Threats

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Outline

- Introduction
- Evolving IM Threats
  - Bullet Impact
  - Shaped Charge Jet Impact
- Emerging IM Threats
  - EFP Warheads
  - Electromagnetic Threats
  - Thermobaric Warheads
  - Terrorist Specific Threats:
    - Improvised Explosive Devices
- Conclusion and Recommendations

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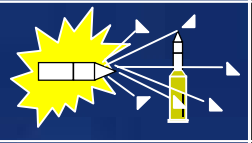
Introduction

Threat Type	Stimuli	Test Procedures	
Thermal Threats	Fast Cook-off (FCO) or Fast Heating (FH) 	STANAG 4240 Edition 2	MIL-STD-2105 C
	Slow Cook-off (SCO) or Slow Heating (SH) 	STANAG 4382 Edition 2	
Mechanical Threats	Bullet Impact (BI) 	STANAG 4241 Edition 2	
	Fragment Impact (FI) 	STANAG 4496 Edition 1	
	Shaped Charged Jet Impact (SCJI) 	STANAG 4526 Edition 1	
Combined Threats	Sympathetic Reaction (SR) 	STANAG 4396 Edition 2	

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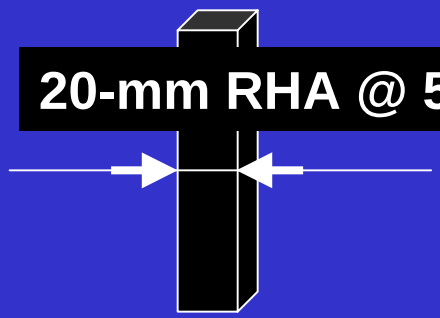
Bullet Threats

1985

Sniper/Hunting rifles
7.62-mm to 7.92-mm

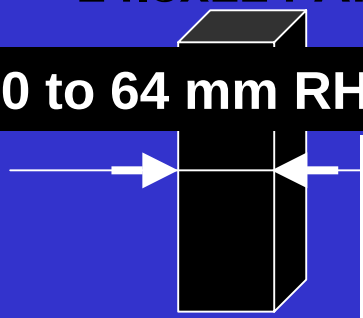
IM and HC
Specified Stimuli:
12.7x99 AP M2 bullet

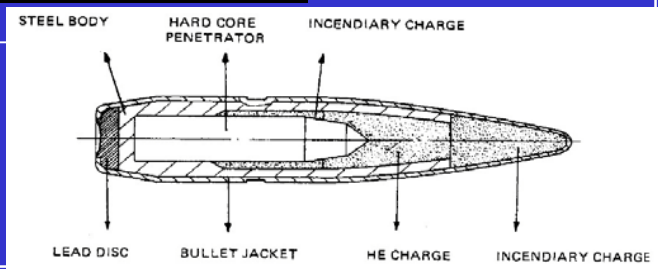


2005

Sniper/Anti-material rifles:
12.7-mm to 20-mm

Available bullets:
- **12.7x99 API M8**
- **12.7x99 MP**
- **12.7x99 SLAP**
- **14.5x114 API**





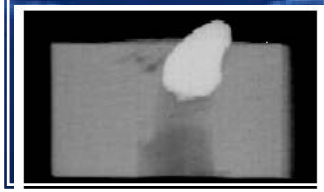
Bullet Threats: IM Assessment

1985

12.7-mm AP M2 Bullet
Reaction Mechanisms:
- DDT
- BVR
- Bore Effects (3)

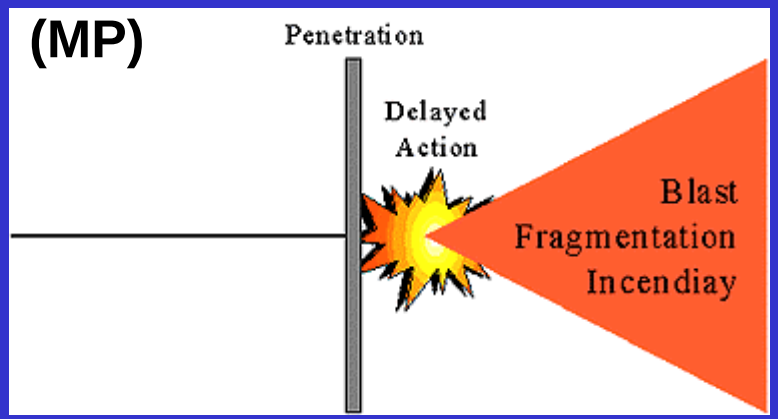
Armor Penetration

SLAP **AP M2**



2005

New bullets
Reaction Mechanisms:
- Same as before +
  - Incendiary effects (API)
  - Explosive and incendiary effects



- Less venting (SLAP)?

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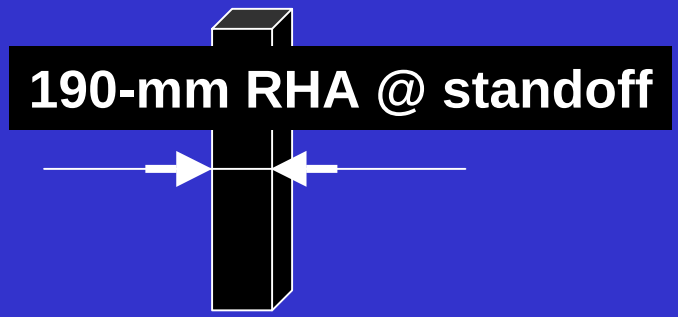
Shaped Charge Threats

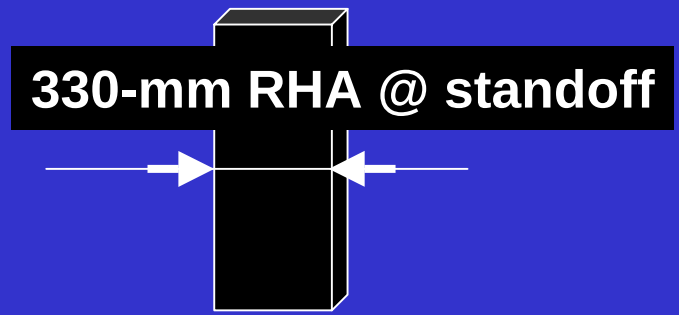
MK-118 Rockeye
50-mm Shaped Charge

IM Threat Stimuli
STANAG 4526



RPG-7 (all versions):
Availability: 40+ Nations
Iraq: 272 RPG attacks in Sept. 2004

Shaped Charge caliber: 70.5 to 85 mm
RPG 7V HE: RDX/Wax



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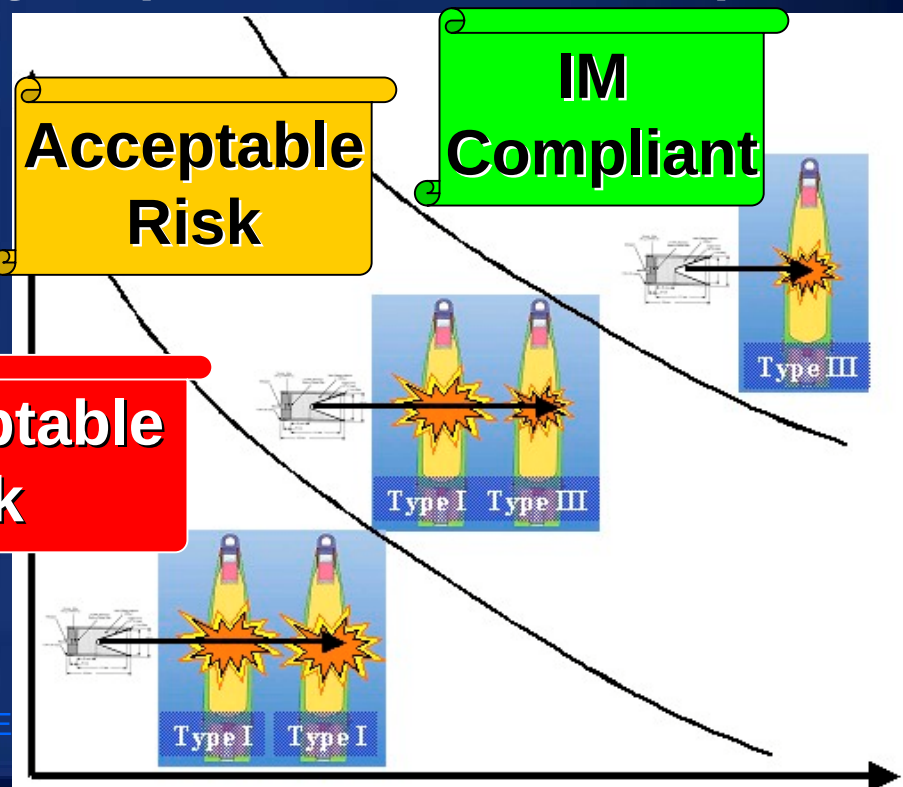
Shaped Charge Threats: IM Assessment

- **Recommendations:**
  - Selection of a new shaped charge representative of RPG threats for AUR tests (same SC to be used for spall impact)
  - Use small-scale and modeling to predict the AUR response (prediction of SDT and BSDT using validated models)
  - Assessment of the risk level
    - ALARP Principle



Explosively Formed Penetrators (EFP)

- **New Generation of munitions (started to enter into service in middle 90's)**
  - Artillery sub-munitions (BONUS, SADARM, SMArt, etc.)
  - Air-delivered sub-munitions (BLU-108)
  - Top-attack anti-tank missiles (e.g., Predator missile)

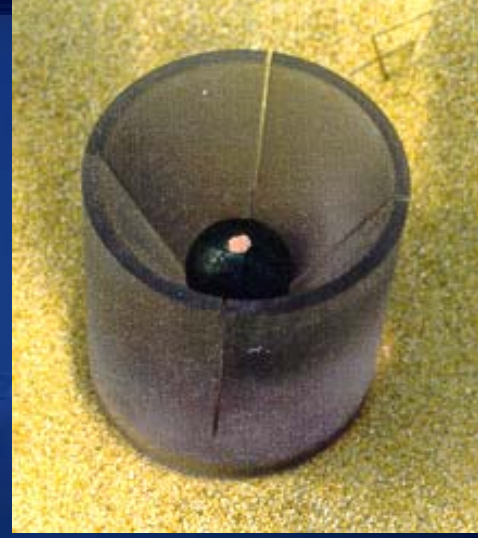
BLU-108
Sub-munition

- **Main threat characteristics**
  - EFP charge: calibre between 130 and 145 mm
  - EFP projectile:
    - Mass: 400+ grams
    - Velocity: 2000+ m/s
    - Material: e.g., Tantalum

BONUS Artillery Shell

- **Availability:**
  - Limited to a few Nations, but…

EFP: IM Assessment



- **EFP impact: not covered by any IM test**
  - French Heavy Fragment Impact:
    - too light (250 grams) and too slow (2000 m/s)
    - Other issue: high density material (penetrator)

- **Proposal: EFP IM Assessment = SCJI approach**
  - Response Goal: type III
  - Response assessed by Small-scale Testing and Modeling (SDT mechanism)

Intentional ElectroMagnetic Interference (IEMI) Threats

Higher Frequency

	Environment				
Parameter	Radar/EW/EMI	HEMP	Lightning	HPM* (NB)	HPM (WB)
Typical frequency	200 kHz to 35 GHz	DC to 100 MHz**	DC to 10 MHz***	100 MHz to 5 GHz	100 MHz to 3 GHz
Typical peak power density (W/cm^2)	Up to 10 (at 10 m)	650 (CONUS-wide)	Up to 750 (at I km)#	Up to 10^4 (at 1 km)	–
Range-electric field product (Volts)	–	–	–	–	~ 1 MV
Typical pulse-width	10 ns to CW	Hundreds of nano-seconds to seconds	500 ns to 100 ms	10 ns to 1 ms	0.3 ns
System effect	Interference, degradation, or mission upset	Upset and damage	Upset and damage	Upset and damage	Upset and damage

System Safety / S3

Factor 10+

Very Short pulse

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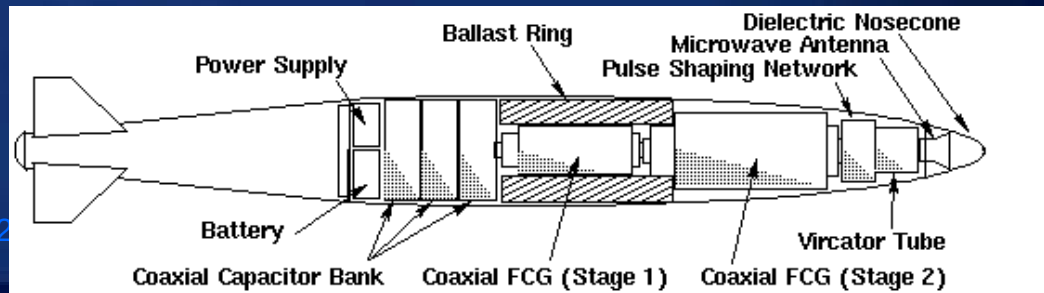
IEMI: IM Assessment

BLU-114
Sub-munition

- **Probability of the threat:**
  - HPM bombs available in Russia (China?)
  - RF weapons in development
  - Terrorist-type solutions

- **Recommendation:**
  - Development of IEMI THA
  - Assessment of current munitions electronics, ESAD and EEDs
  - Development of international standardized test procedures



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Thermobaric Threats

- **Thermobaric munitions**
  - Individual weapons (RPO-A, RShG-1, 40mm CTG)
  - Artillery ammunition (Buratino, Uragan, etc)
  - Guided missiles (AGM-114 TBX, AT-14)
  - Bombs (e.g., BLU-118)

- **Probability**
  - RPO-A widely available ($ 2,000)
    - Congo, Sri-Lanka, Afghanistan, etc.

- **Thermobaric warheads: enhanced thermal and blast effects (see Duncan Watt presentation)**

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Thermobaric Threats: IM Assessment

- **Thermobaric induced stimuli:**
  - Munition crushed and punctured, low velocity debris impacts caused by the building collapse
    - see following slides
  - Ignition of combustible materials and sustained fire
    - Cook-off threats covered by FCO
  - The ignition and the sustained burning of ordnance by incendiary pellets
    - Internal ignition of Energetic Mat. by incendiary pellets
- **Recommendations**
  - Test program to assess TBX / incendiary pellets effects on IM

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Terrorist Threats

Iraq
US Air Base
02/06/04

- **Terrorist threats:**
  - RPGs attacks (e.g., Iraq, Oct. 03 – Ammo Truck)
  - Lobbed rockets, mortar attacks - Examples
    - June 2002, Afghanistan
    - June 2004, Iraq (2 on ammunition)
    - July 2004, Afghanistan
  - IEDs - An IED can be almost anything with any type of explosive material and initiator.
    - Package type IED
    - Vehicle Borne-IED (VIEDs)
    - Suicide Bomb IED

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Terrorist Threats and IM Stimuli

- **RPGs, Lobbed Rockets, Mortars: IM threats (FI, SCJI)**
- **IEDs:**
  - **Package-type and Suicide bomb IEDs: IM Threats (FI, SR, Blast) – high probability (Iraq: 826 attacks in Sept. 04)**
  - **VIEDs: not covered – medium probability (Iraq: 40 attacks in Sept. 04)**

ATF	Vehicle Description	Maximum Explosives Capacity	Lethal Air Blast Range	Minimum Evacuation Distance	Falling Glass Hazard
	Compact Sedan	500 pounds 227 Kilos (In Trunk)	100 Feet 30 Meters	1,500 Feet 457 Meters	1,250 Feet 381 Meters
	Full Size Sedan	1,000 Pounds 455 Kilos (In Trunk)	125 Feet 38 Meters	1,750 Feet 534 Meters	1,750 Feet 534 Meters
	Passenger Van or Cargo Van	4,000 Pounds 1,818 Kilos	200 Feet 61 Meters	2,750 Feet 838 Meters	2,750 Feet 838 Meters
	Small Box Van (14 Ft. box)	10,000 Pounds 4,545 Kilos	300 Feet 91 Meters	3,750 Feet 1,143 Meters	3,750 Feet 1,143 Meters
	Box Van or Water/Fuel Truck	30,000 Pounds 13,636 Kilos	450 Feet 137 Meters	6,500 Feet 1,982 Meters	6,500 Feet 1,982 Meters
	Semi-Trailer	60,000 Pounds 27,273 Kilos	600 Feet 183 Meters	7,000 Feet 2,134 Meters	7,000 Feet 2,134 Meters

VIEDs: Consequences and IM Assessment

- **Consequences:**
  - The projection of complete munitions and/or munitions containers impacting different surfaces (e.g., spigot)
  - The crush of munitions by elements from destroyed/damaged building structures, projected materials, etc.
  - Large low-velocity fragments (sizes, density, hardness and shapes)
- **IM Assessment:**
  - AUR test can not represent the threat spectrum (Drop or spigot tests, corner plate tests, etc.)
  - Use SSTM to assess the sensitivity of munitions, for example
    - Susan Impact, Steven Test, ELVIS Approach
    - Sensitivity Groups Approach?

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Recommendations

- **Traditional IM threats remain**
  - Cook-off, sympathetic reaction, high-velocity light fragments
- **Some IM threats have evolved**
  - Bullets with additional effects
  - Shaped charge jet: RPG instead of sub-munitions
- **Some existing threats never really considered**
  - Projection of complete munitions, Crush, puncture of munitions case and impact by large low-velocity fragments
    - Susan test, Steven Test, ELVIS, etc could be of interest for the IM Assessment
    - The Hazard Classification community is investigating the concept of Sensitivity Groups

Recommendations and Conclusions

- **Some emerging threats to be considered:**
  - Intentional EM Interference
  - Thermobaric munitions effects
  - Explosively-Formed Penetrators

- **STANAG 4439 Edition 2**
- **AOP-39 Edition 2**

} **In preparation**

Questions?

Job Opportunity in NIMIC/MSIAC

Munitions Systems

Located in Brussels, Belgium

Submission Deadline:
30th November 2004

More info on our website

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