

Session chair

**James
Padfield**

SESSION 2

REGULATION & LEGAL FRAMEWORK

IM Policies & Implementations

National implementation

Philip Cheese *standing for* **Ian Carr**

Team Leader Science and Technology DOSG, DE&S - UK MoD

Lt Col Morten Kjellvang

Chief of Ammunition Safety Section, Defence Material Agency

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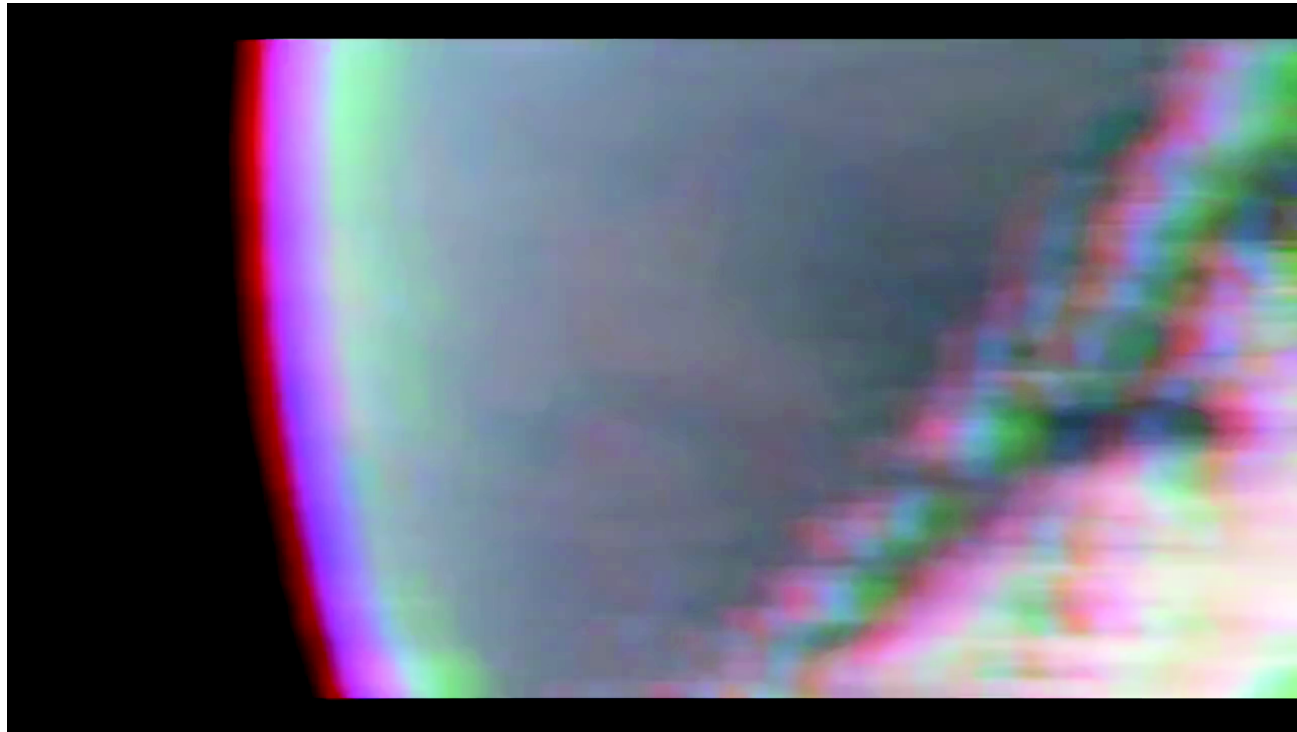
Team Leader Science and Technology DOSG, DE&S - UK MoD

DOSG Science & Technology

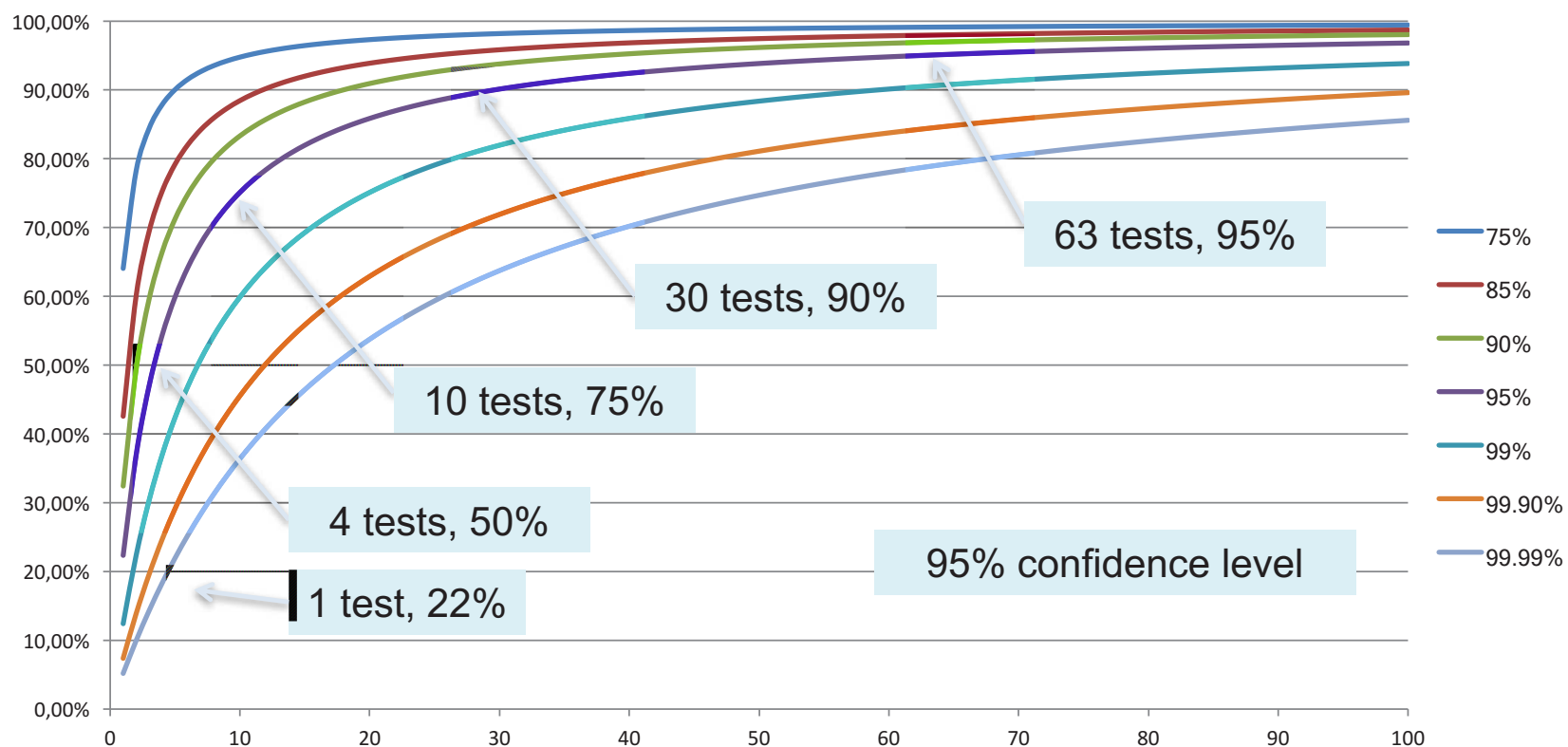
Issues in IM Policy & Regulation: Scarce Data, Variability & Theory

Ian Carr
DOSG Science & Technology Team Leader
19th May 2017

Scarce Data



Confidence Intervals

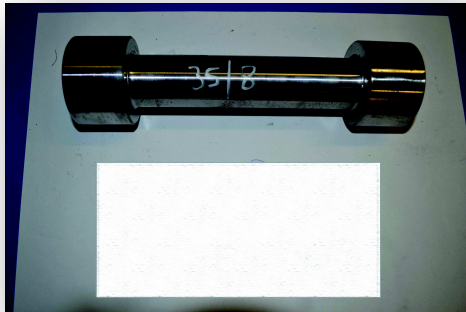
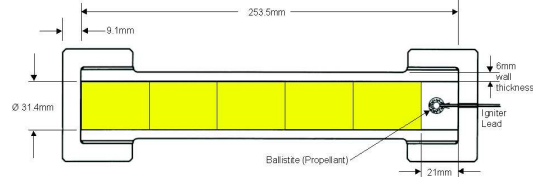


81 mm HE Mortar Bomb - Assessment

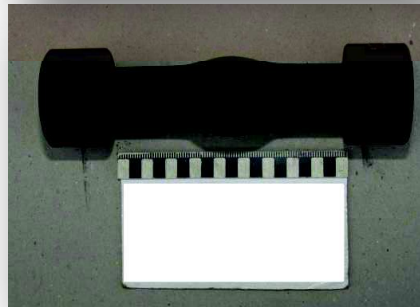
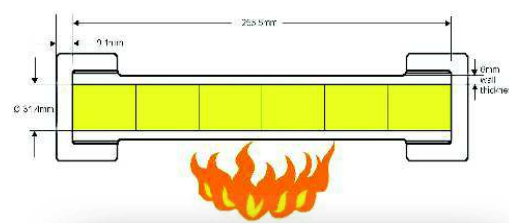
- Hazard Classification: HD 1.2
 - **Single** successful bullet attack
 - 10 “stack” tests on L15A3 (7), L15A4 (3). Up to 15 bombs per test
 - Although no mass detonation, *some acceptors detonated*
- IM Assessment: Type I Detonation (RDX/TNT filling)
 - Based on tube tests
- RATTAM threat 0.5 “ AP
 - What is the risk?
 - HD or IM assessment?
 - Which of these should be used for e.g. Ships Explosive Safety Case?

Variability: Explosiveness

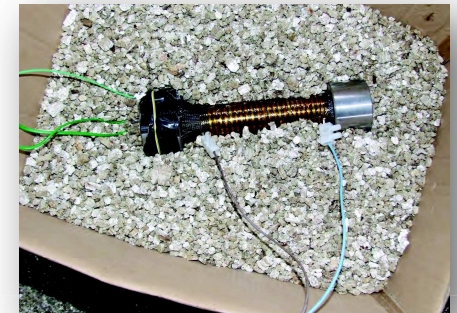
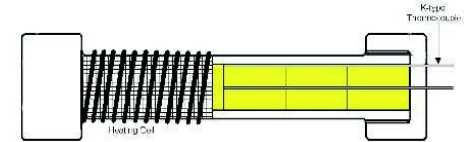
EMTAP 35: Internal Ignition



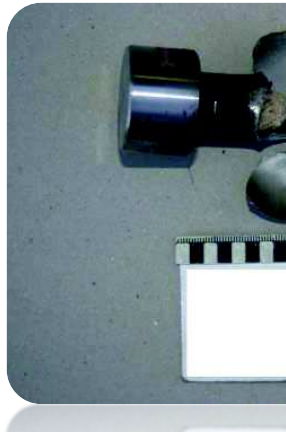
EMTAP 41: Fast Heating



EMTAP 42: Electrically Heated



Screening for DDT



| Category | Reaction Description | Observation |
|----------|---|--|
| 0 | No reaction | From weighing |
| 0/1 | Burning decomposition | No disruption of test vehicle |
| 1 | Pressure burst due to burning/decomposition | Assembly ruptured but one fragment approximates to original weight |
| 2 | Deflagration | 2 to 9 body fragments |
| 3 | Explosion | 10 to 100 body fragments |
| 4 | Detonation | >100 test vehicle body fragments showing evidence of detonation |



Good Response

LOW

Explosiveness

HIGH

Poor Response



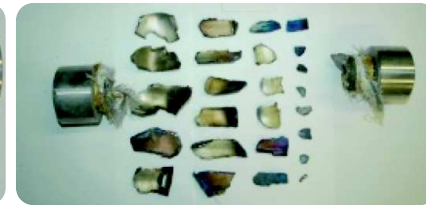
0/1



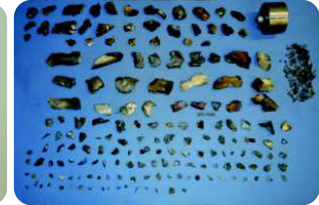
1



2

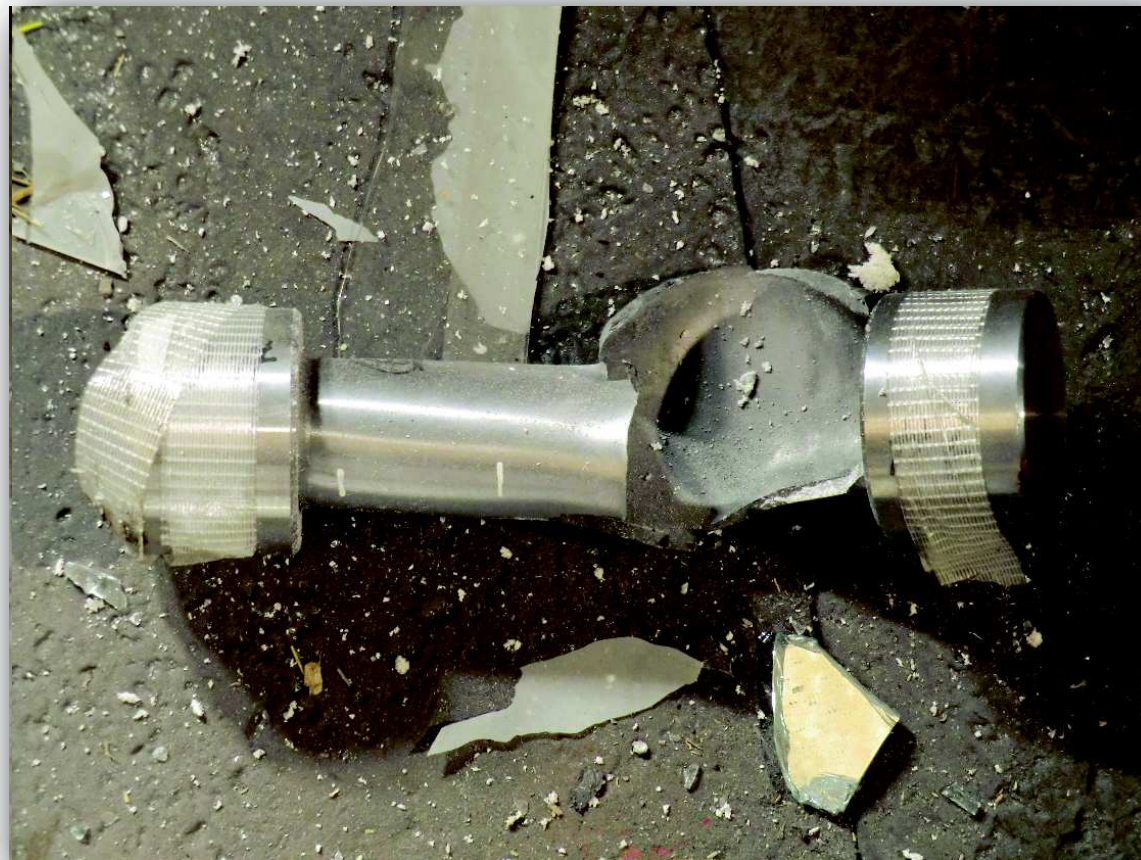
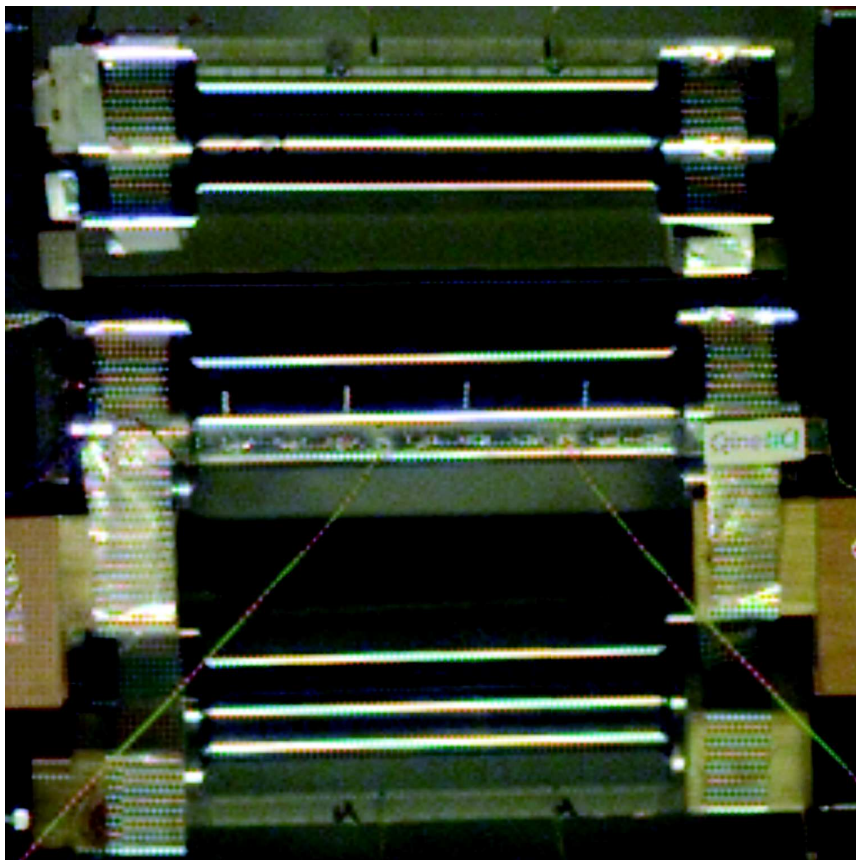


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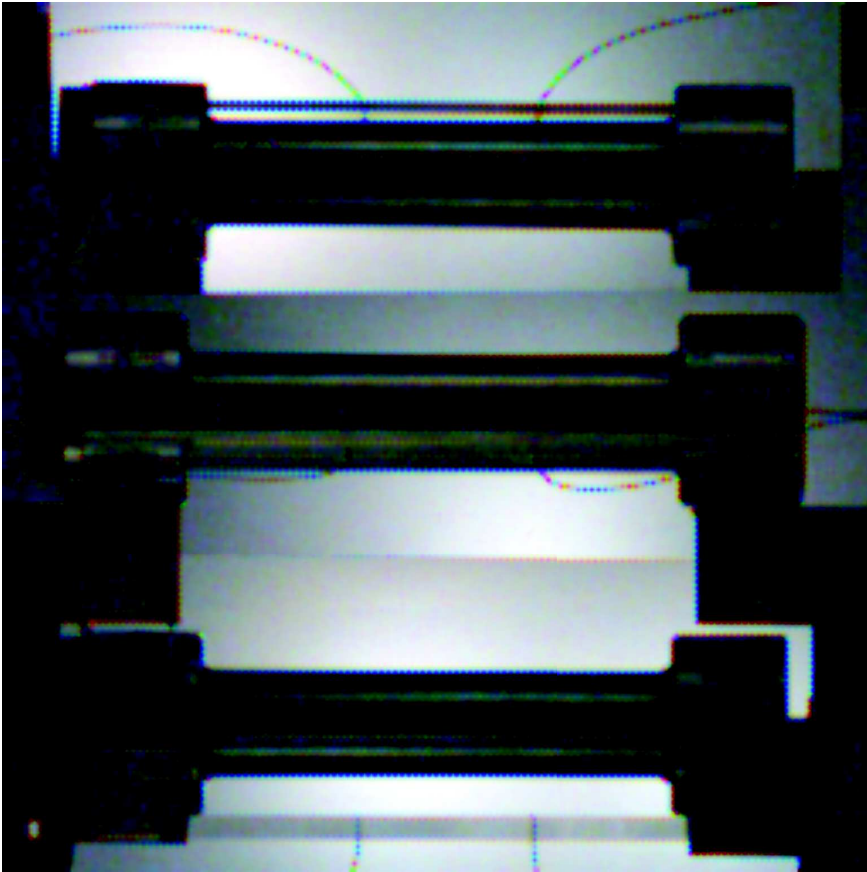


4

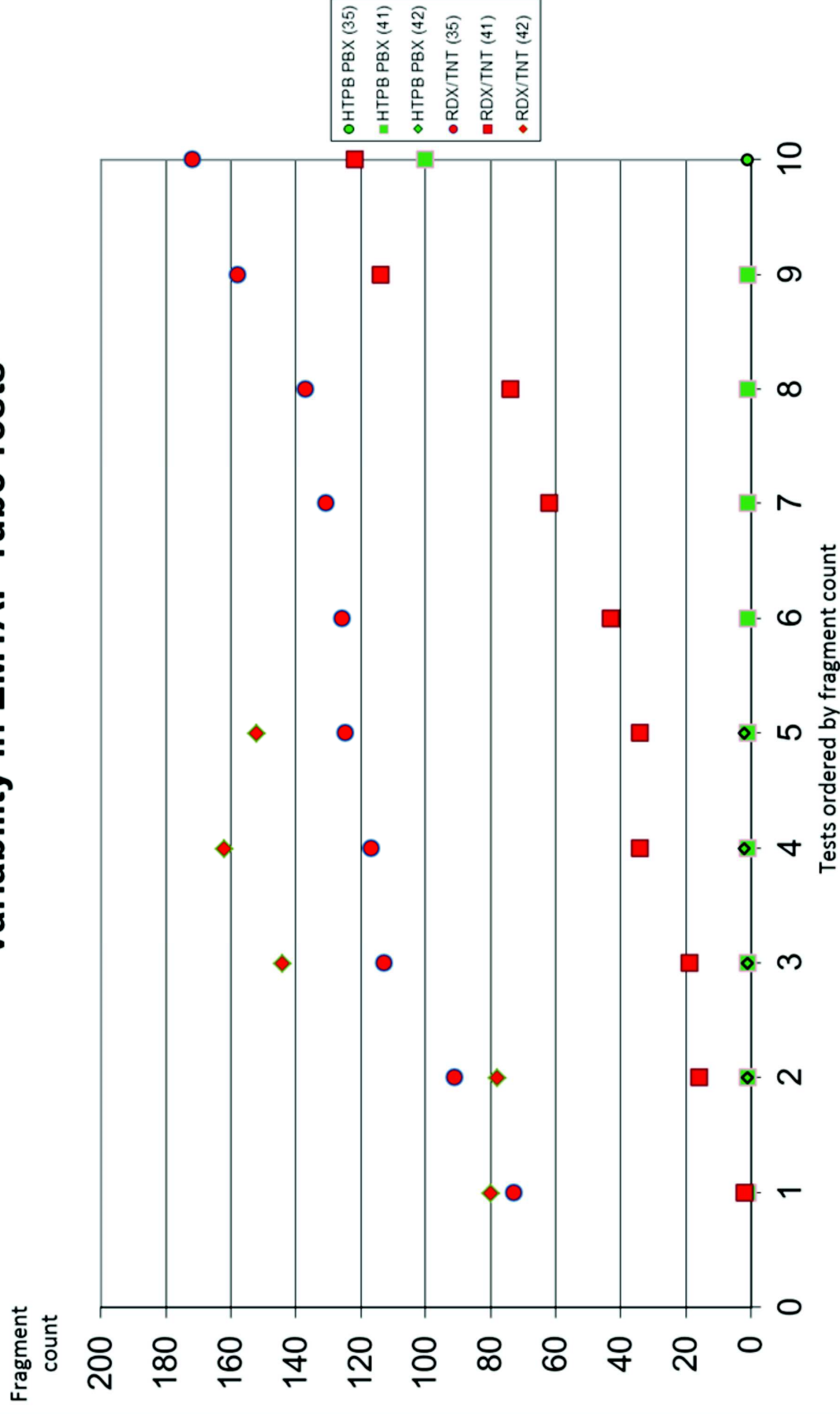
Low Explosiveness



High Explosiveness



Variability in EMTAP Tube Tests



The Question

- Is the variability observed in laboratory scale tests also found in real weapons?
- DOSG ST has begun a series of trials to investigate
- STANAG 4241 Bullet Impact on Mortar Bombs, HE Shell and GP Bombs

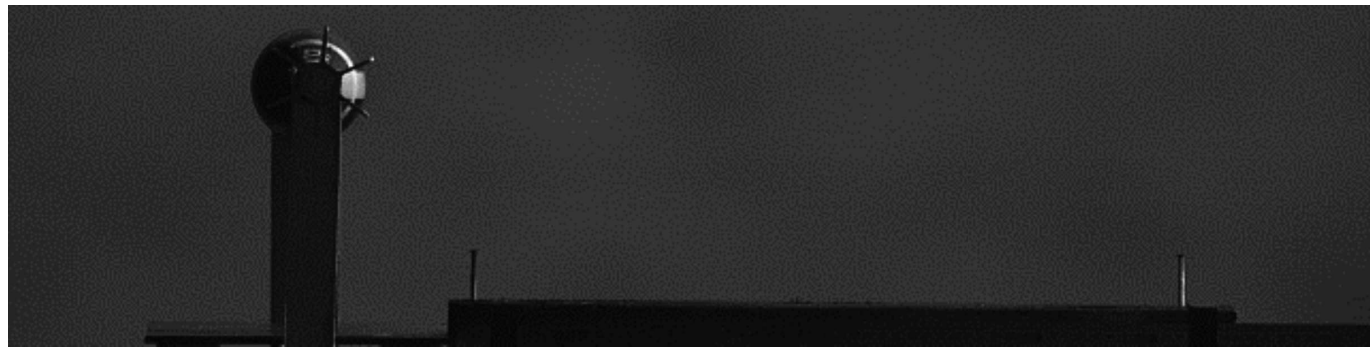
81 mm HE Mortar Bomb – RDX/TNT

Aim Point: Above the Obturating Ring



81 mm HE Mortar Bomb – RDX/TNT

Aim Point: Below the Obturating Ring



Bullet Impact causes delayed propellant initiation

81 mm HE Mortar Bomb – RDX/TNT



Burning Reaction (skip to end for fuze reaction)



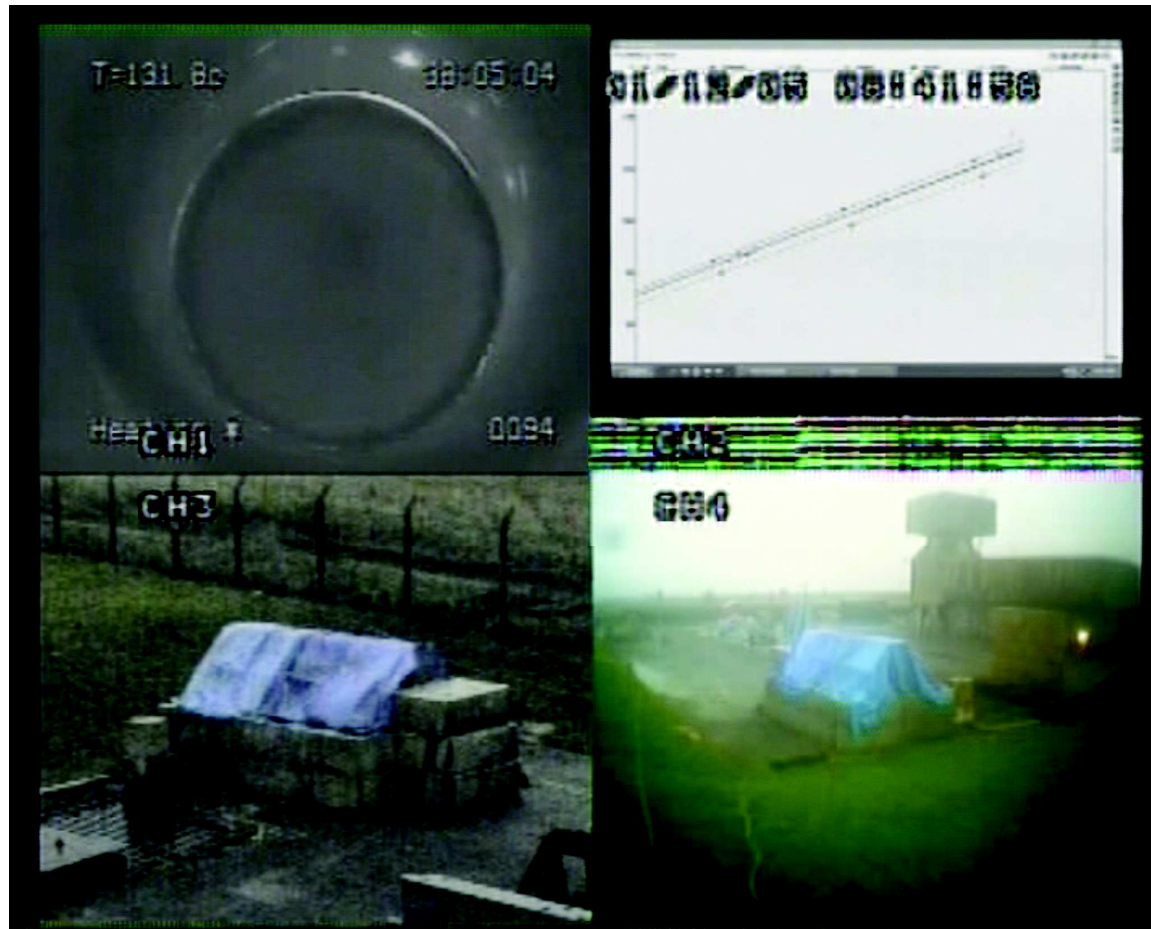
Bullet Impact - No Reaction

47 tests to date – all no reaction or burning

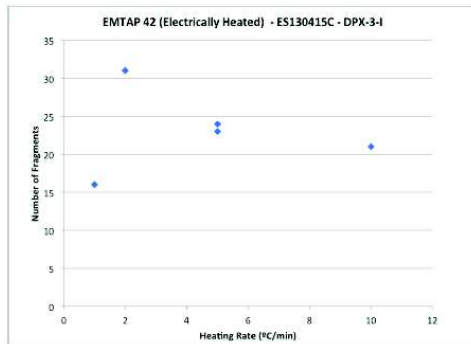
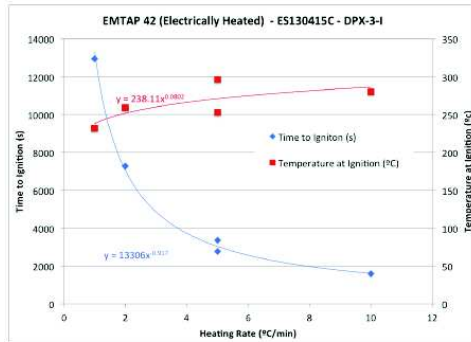
HE Shell: work in progress

| | Reaction | 105 mm HE | 155 mm HE |
|--------------------|-----------------------|-----------|---------------------|
| | No Reaction | 4 | |
| | Burning | | 1 |
| | Deflagration | | 1 |
| | Explosion | | 10 |
| <u>155 mm Burn</u> | Partial Detonation | 7 | <u>m Detonation</u> |
| <u>105 mm Bu</u> | Detonation | | 1 <u>on</u> |

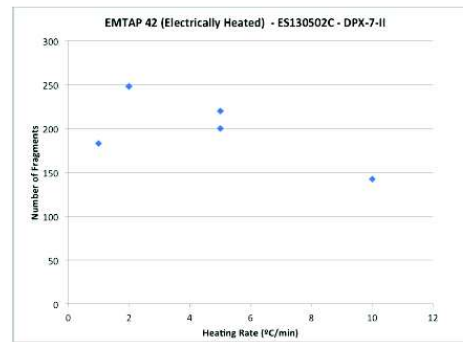
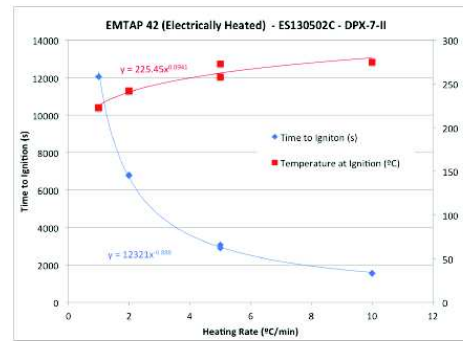
Theory: Cook-off



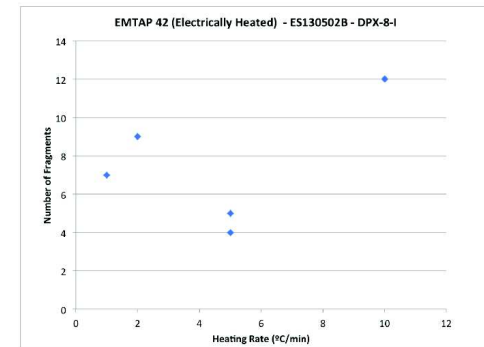
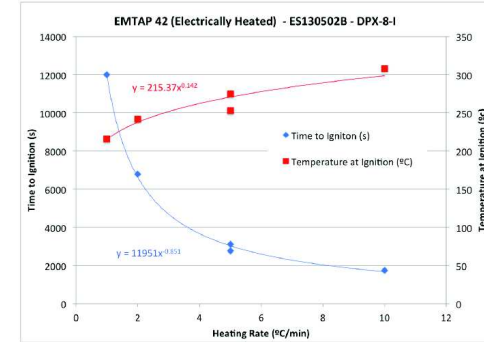




0% Al



10% Al



20% Al

TTCP CP-4-48 Slow Cook-Off:

It took 3 years of meetings, workshops (inc. MSIAC), conferences, collaboration and testing to understand that:

1. SCO is not easy.
2. There is no single point solution for the answer to a SCO heating rate.
3. If through modelling, a testing hierarchy, small scale or full scale AUR testing it is determined that a heating rate of 6°F/hr (3.3°C/hr) is neither a credible threat nor validated to be a worse case reaction or violence scenario, **then there should be protocol in place to test/validate reaction at an alternate heating rate more appropriate to the specific and unique munition under test.**

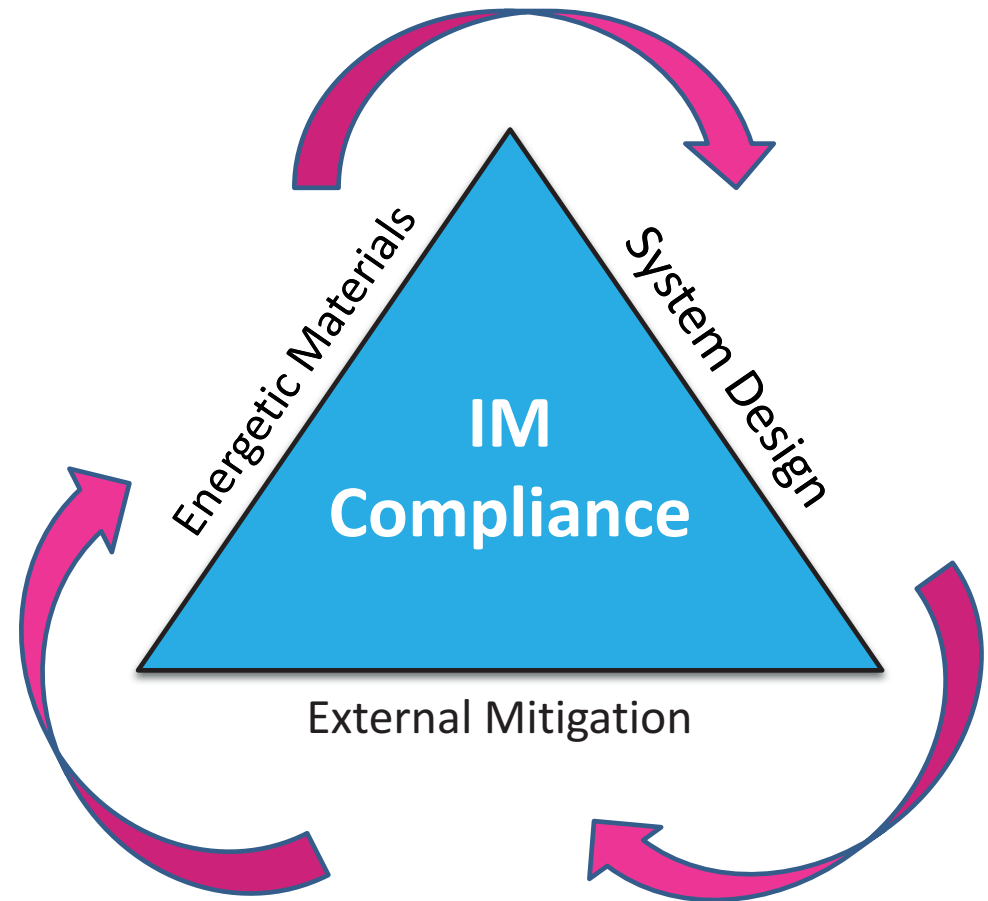
Implications for Authorities

- Can't always trust the 'Admiral's Test'
 - Scarce data, variability and absence of theory
- Need to understand mechanisms/science
 - Hence AOP-39 protocols
- Need the Whole Body of Evidence

IM Compliance – Systems Approach

- Aspects to be considered for IM:

- Energetic Materials
- Design & Construction
- Tactical Packaging
- Logistic Packaging
- External Mitigation
- Platform integration
- Statistics!



Issues for Manufacturers

- Should be designing safer weapons
 - Not just to pass “the” test
- Need confidence in design
 - Theory, statistics
- The contract?

UK approach to new procurement (replacing the IM Waiver)

1) IM policy incorporated into initial URD as a KUR

- FLC/ODH shall include need to comply with JSP520 Pt 1
- PT to support FLC/ODH to develop IM requirement

2) Identify Proposed **Target IM Signature** prior to Initial Gate

- Produced by IMAP on request
- Requirements, current technology & materials, MTDS
- Derived from technology available – does not consider cost

3) Identify **Contractual IM Signature** for Main Gate

- Owned by PT; is response to Target Signature
- Agree with suppliers/manufacturers/FLC/ODH what is possible (time, cost & performance)
- Identify, justify & agree (IMAP) deviations from target signature

4) Review throughout lifecycle

- PT must develop a strategy for delivering IM Compliance
- Hazards are captured and managed effectively



Conclusions

- Manufacturers, procurement organisations and authorities need to work closely from the outset to meet requirements as far as current technology permits, whilst managing user expectations
- More research is needed 😊