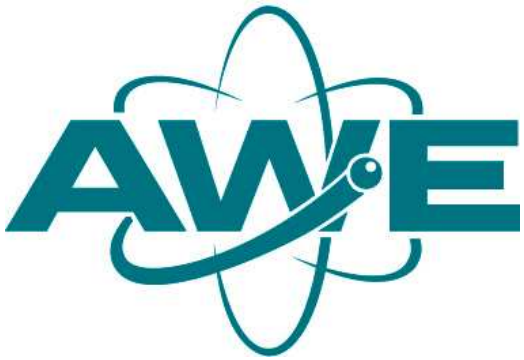

Simple measurements to support an early assessment of the performance and shock sensitivity of new IM ingredients

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Overview

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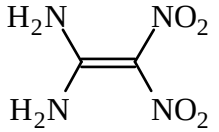
  - Background
  - Test Compositions
- Manufacture
  - Powder Hazard Test Results
  - Charge Manufacture
- Performance Testing
  - Test Configuration
  - V of D results
  - Shock Sensitivity results
- Conclusions
- Future Work

Background

- Two explosive molecules under investigation as candidates for IM booster compositions
  - Fox-7
  - LLM-105 (PZO)
- Aim to rank shock sensitivity of these materials and gain an indication of performance at early stage of development.
- Small scale instrumented gap test carried out.
- PBX-N7 (RDX/TATB/Viton) and HMX / Viton compositions used for comparison

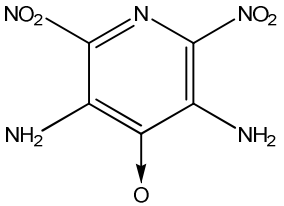
Test Compositions

- Fox-7 / Viton-A 95:5 wt%
  - NSF 110 (mean size: 42 micron)
  - NSF 120 (mean size: 110 micron)



Fox-7

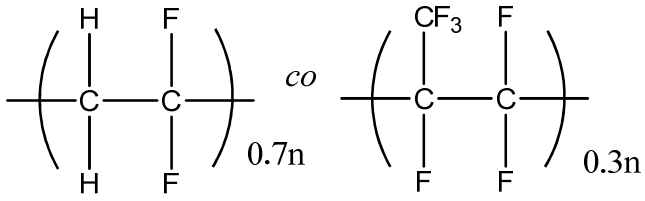
- LLM-105 / Viton-A 95:5 wt%
  - LLM-105 grade IHP3



LLM-105

- PBX N7 (RDX/TATB/Viton-A) (35:60:5 wt%)
- HMX / Viton 90:10 wt%

Viton A



Powder Manufacture

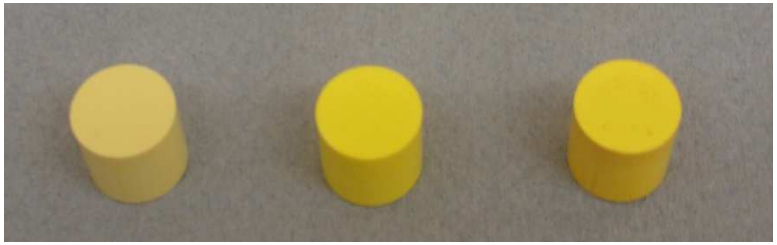
- PBXN7 supplied by BAE, made using slurry mixing process
- Moulding powders of HMX/Viton, Fox-7 and LLM-105 compositions were prepared in 500 gram batches in an IKA HKV1 dual planetary mixer using a solvent paste process

Powder hazard test results

Test	Results			
	PBX-N7	Fox-7 / Viton (42 micron)	Fox-7 / Viton (110 micron)	LLM-105 / Viton
Figure of insensitiveness (EMTAP test 1A)	70	101	90	78
Temperature of ignition / ^{o}C (EMTAP test 3)	217	226.5	227	323
Trough test (EMTAP test 5)	Ignites and burns steadily	Ignites and burns steadily	Ignites and burns steadily	Ignites and burns steadily
Spark test (EMTAP test 6)	Ignitions at 4.5J, no ignitions at 0.45 J	Ignitions at 4.5J, no ignitions at 0.45 J	Ignitions at 4.5J, no ignitions at 0.45J	No ignitions at 4.5J

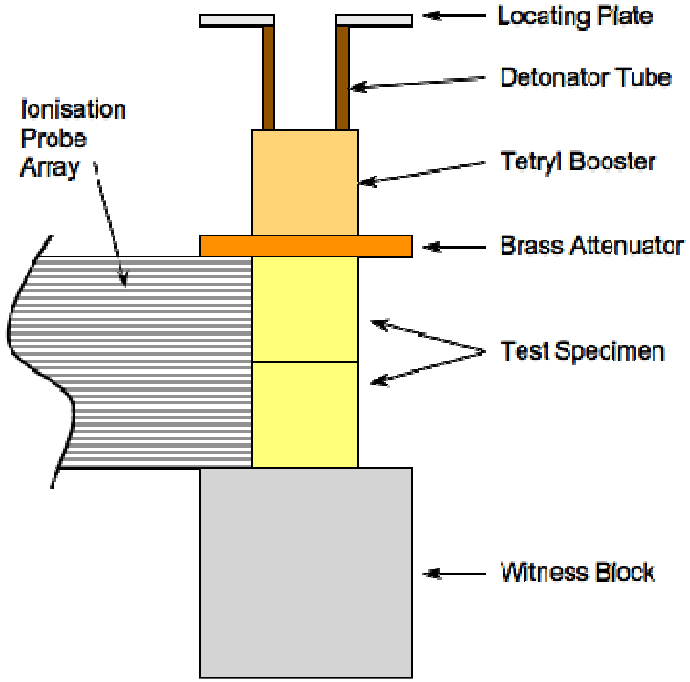
Charge Manufacture

- Gap test samples, 12.7 mm diameter by 12.7 mm height produced by die pressing



Composition	Pressed density (% TMD)
PBXN7	97
HMX/Viton	98.4
Fox-7 / viton (42 micron)	98.6
Fox-7 / viton (110 micron)	98.6
LLM-105 / viton	95

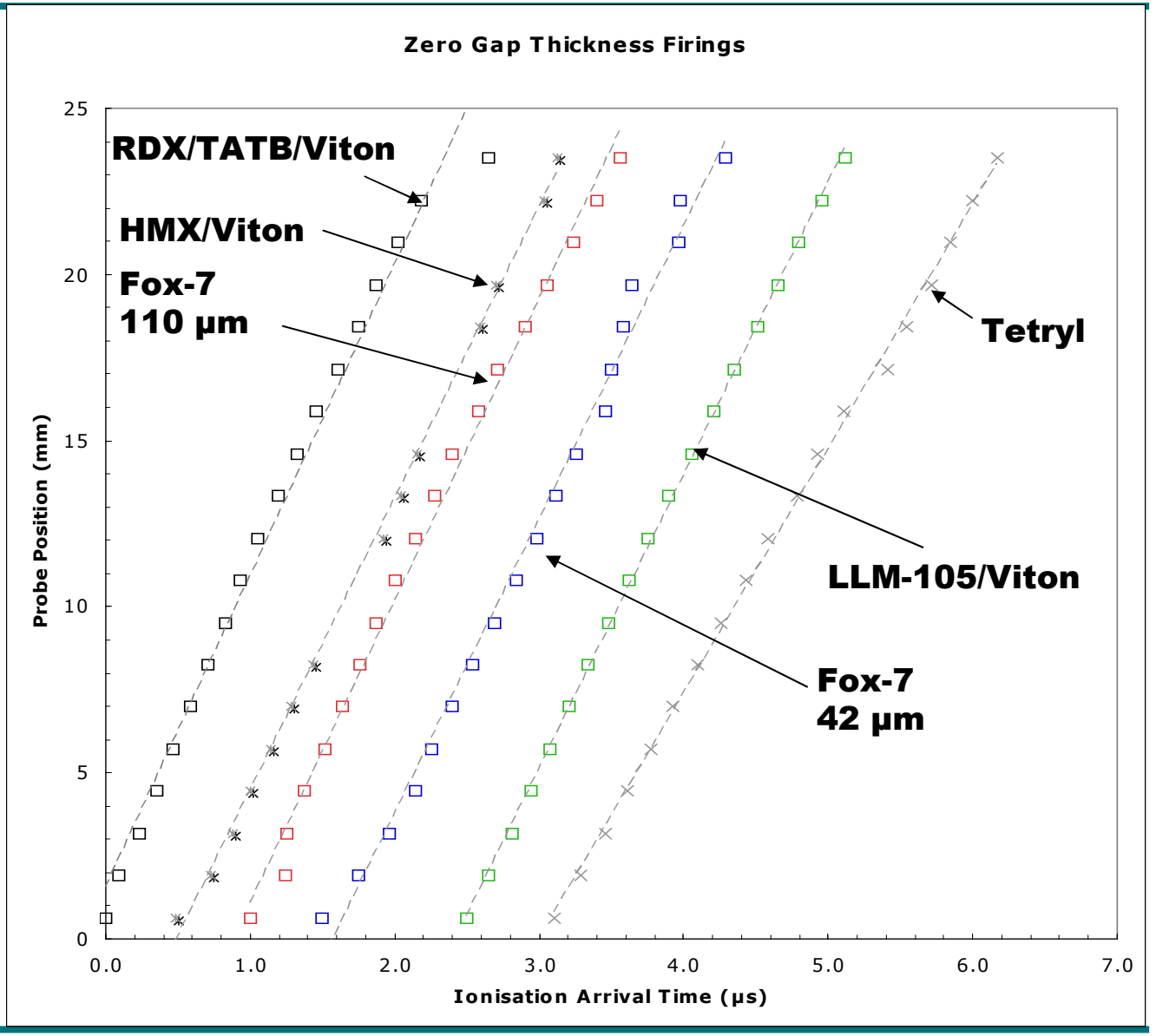
Performance Testing - Small scale instrumented gap test (SSIGT)



- EMTAP test 11 with added diagnostics.
- Tetryl input pellet 12.7 mm x 12.7 mm 1.5 g/cc
- 10 tests, no-go gap thickness identified.
- Ionisation probes give indication of V of D and shock breakout distance.
- Early stage test, used for comparative data.
- Low material quantity required

Performance Results

- Firings with no attenuator carried out to estimate V of D
- Tetryl shown for comparison.



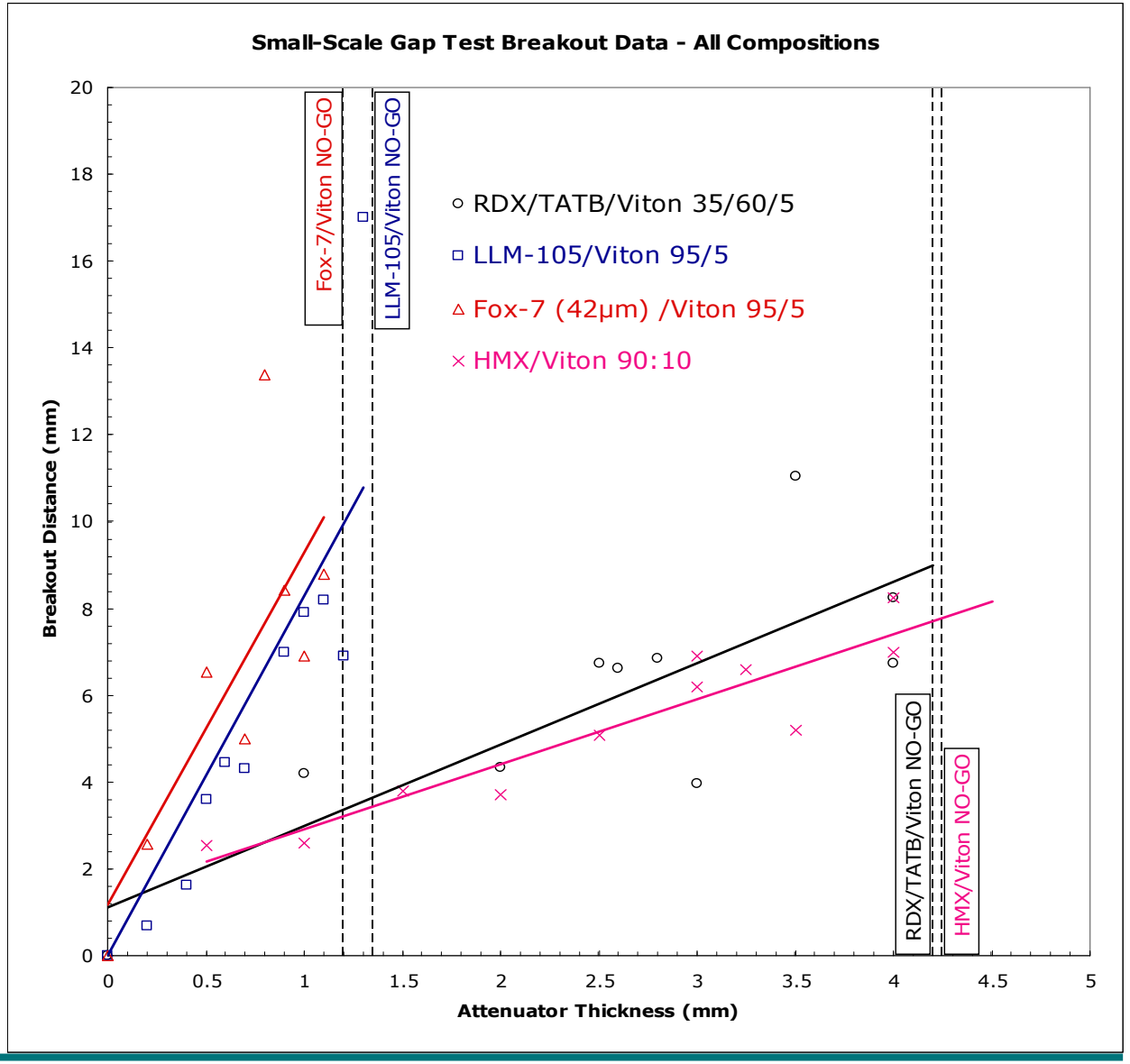
Summary of performance measurements

Composition	Measured V of D (mm/μs)	Calculated V of D (Cheetah v 4.0) (mm/μs)
LLM-105 / Viton	8.84	7.89
Fox-7 (110μm) / Viton	9.08	8.44
Fox-7 (42μm) / Viton	8.85	8.44
RDX / TATB / Viton	9.35	7.98
HMX / Viton (90:10)	8.79	8.69

- VoD measurements allow rough ranking of materials.
- Calculated data has poor agreement with experimental.
- Small sample diameter of test samples must be considered however.
- Larger scale test would be needed to gain more accurate measurement

Combined Gap test data

- Plots of breakout distance vs attenuator thickness
- No-go thresholds shown
- Results for 110 micron Fox-7 inconclusive.
  - No steady detonation observed with any gap
- Higher no-go threshold for CHE's can be seen
- Slope of Fox-7 and LLM-105 plots steeper than CHE materials



Summary of gap test results

Composition	No-go attenuator thickness (mm)
RDX / TATB / Viton	4.2
LLM-105 / Viton	1.35
Fox-7 (42μm) / Viton	1.2
Fox-7 (110μm) / Viton	Inconclusive
HMX / Viton (90:10)	4.3

Conclusions

- Gap test has shown that Fox-7 and LLM-105 compositions are less shock sensitive than PBXN7 and HMX / Viton
- Results of LLM-105 composition show a similar level of shock sensitivity to the Fox-7 viton.
  - Higher press density would further reduce sensitivity of LLM-105
- Larger particle sizes of Fox-7 appear to be less sensitive to shock

Future Work

- This is part of a larger programme of work
  - Larger scale performance testing will be undertaken to gain accurate measurements of velocity and pressure of detonation.
  - Porosity effects on shock sensitivity will be investigated to allow optimisation of pressing density for a booster application.
  - Thermal cook-off vulnerability will be investigated.

Questions