DOSG Science & Technology

An Investigation into Unknown-to-Detonation (XDT) Thresholds Using Charge Scale Testing

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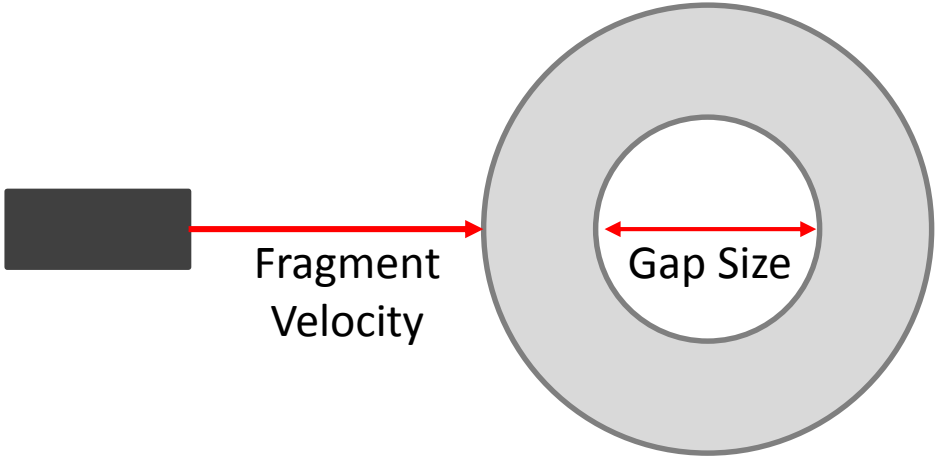
DOSG Science & Technology – Energetics Vulnerability
Insensitive Munitions and Energetic Materials Symposium – Seville, 2019

Overview

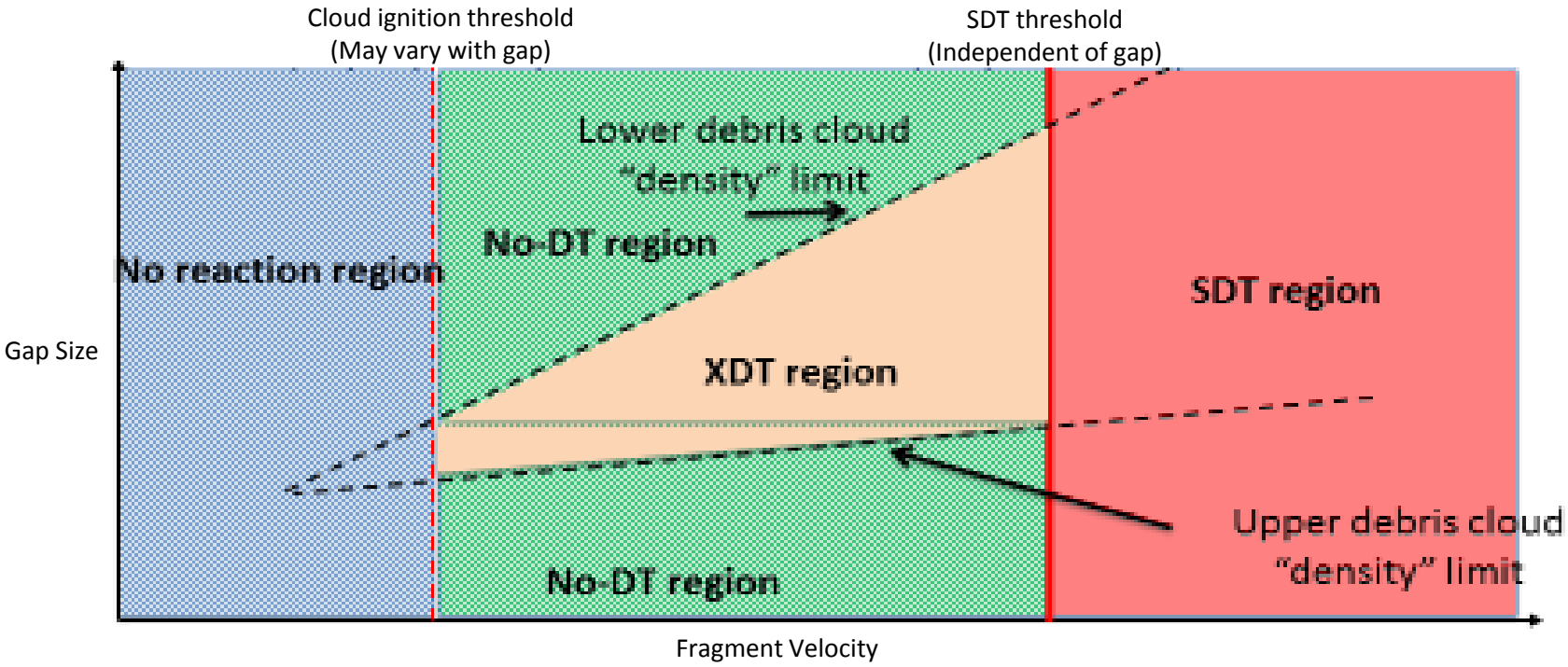
- Introduction
- Trials Hypothesis
- Trials Programme
- Outcomes
- Conclusions
- Further Work
- Questions

Introduction

- XDT Thresholds are not well understood
- Work was commissioned in the UK to investigate whether any patterns in XDT phenomena can be found
- Trials specifically investigating the relationship between ‘gap size’ and fragment velocity



Trials Hypothesis

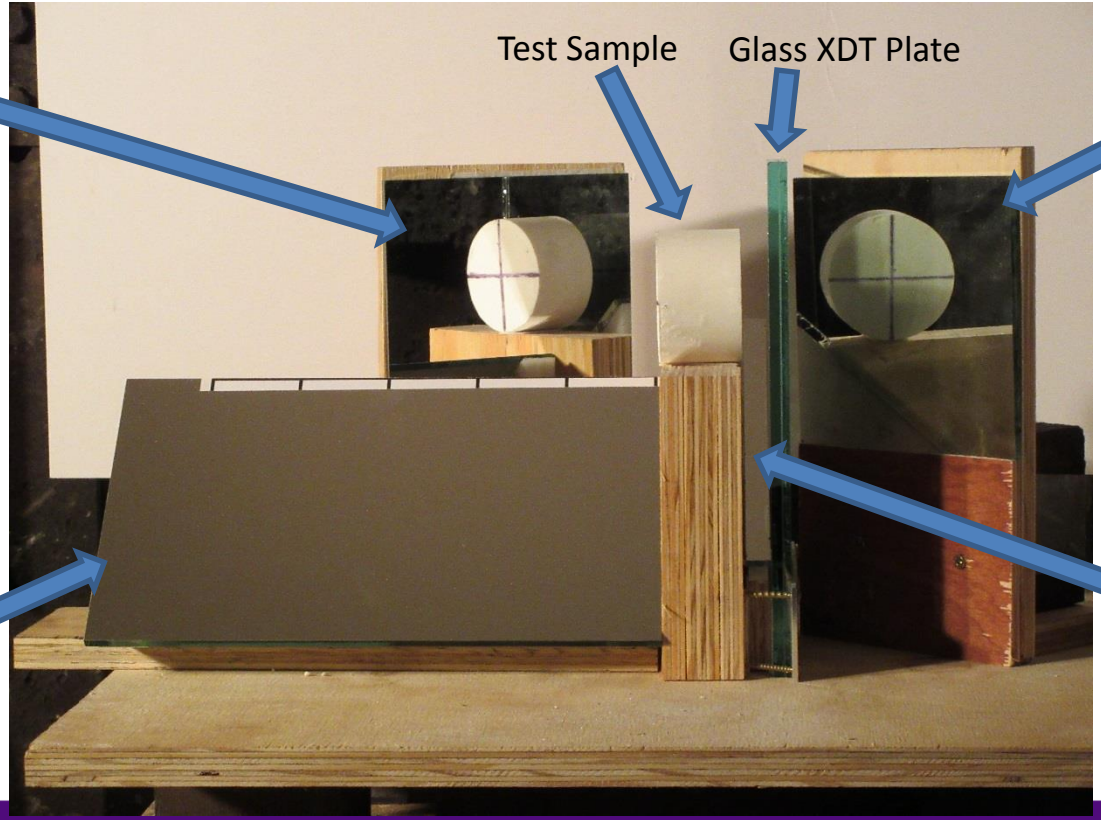


Trials Programme

- Pressed pellets of DPX 2 Type II
- 6mm Steel Plate in front of test sample (drives the SDT Threshold higher)
- EMTAP Fragment (very similar to STANAG Fragment – but flat faced) fired from a 30mm rifled gun
- Glass rear ‘XDT plate’ – glass chosen so that the cloud can be observed using a mirror
- Fire at a consistent gap until Ignition, SDT and XDT have all been identified
- Fire at a consistent velocity until Ignition and XDT have been identified
- Continue to do the same across various gap sizes and velocities to populate the graph

Test Arrangement

Angled front mirror
- To view front face for accuracy



Angled back mirror
- To view rear face behaviour

Angled mirror
- For velocity and pitch/yaw measurements

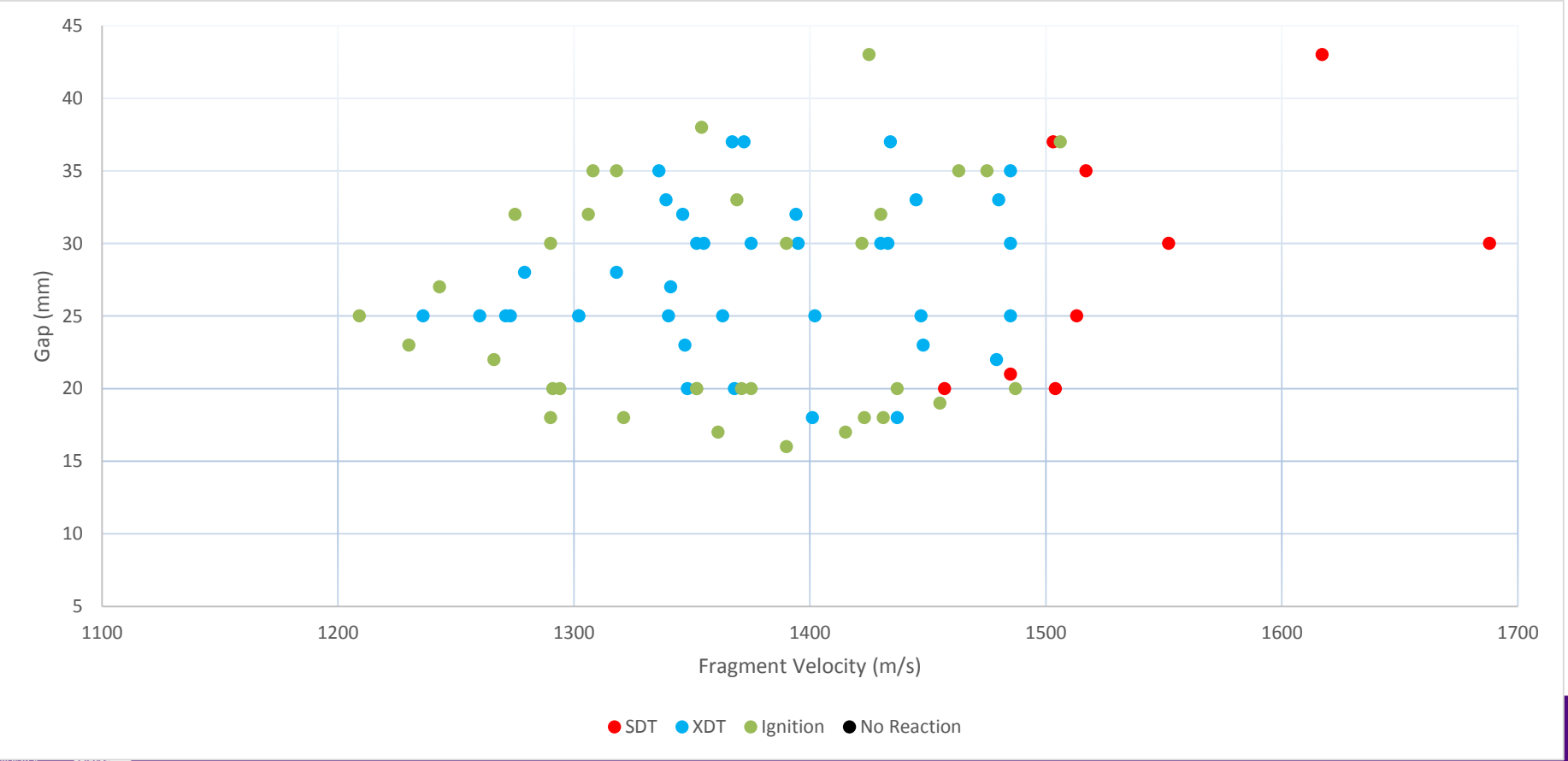
Angled interstitial mirror
- To view 'cloud' formation and behaviour

SDT Example Video

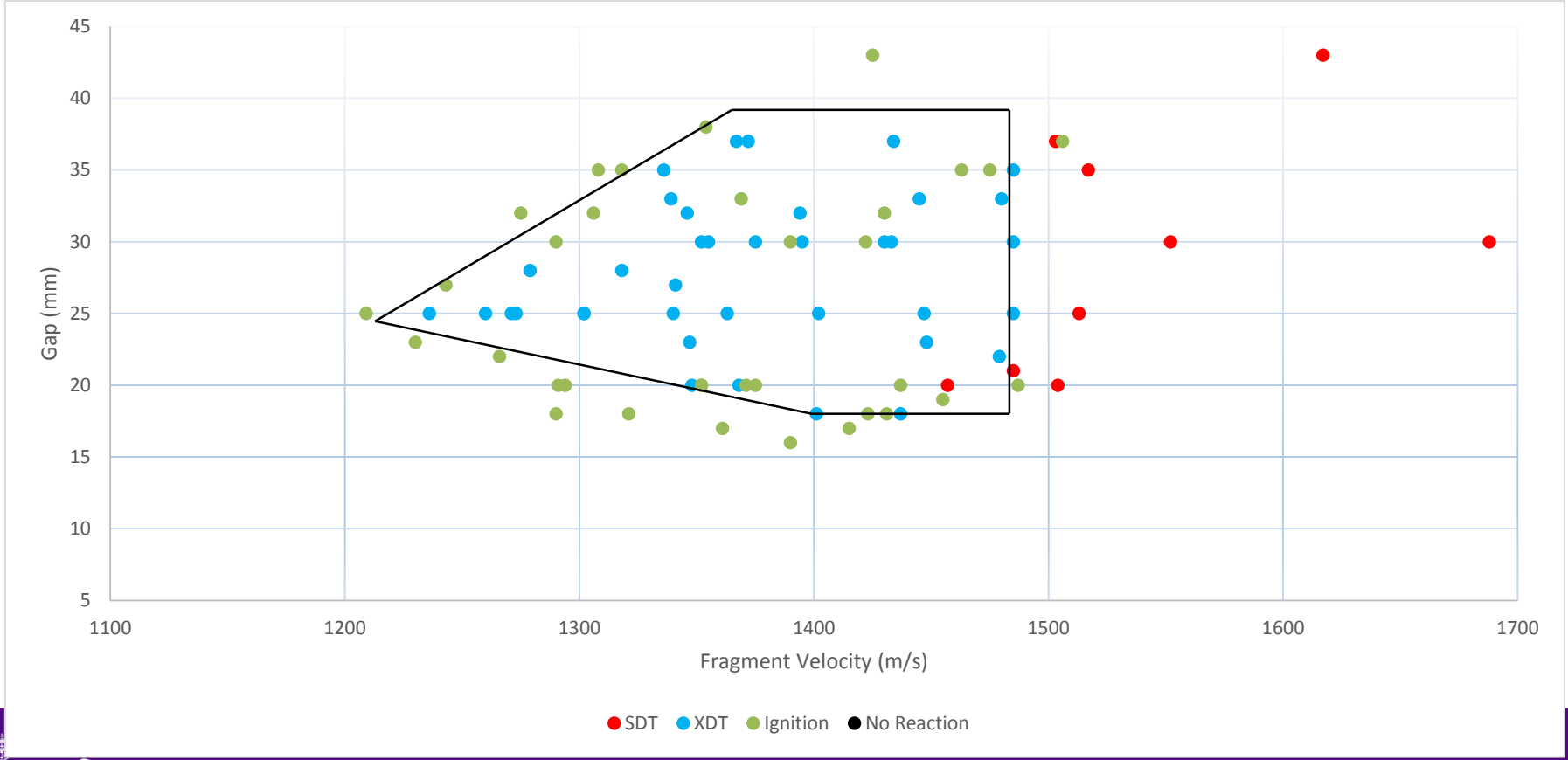
Ignition Example Video

XDT Example Video

Outcomes


45
40
35
30
25
20
15
10
5
Gap (mm)
1100
1200
1300
1400
1500
1600
1700
Fragment Velocity (m/s)
SDT
XDT
Ignition
No Reaction

Trends?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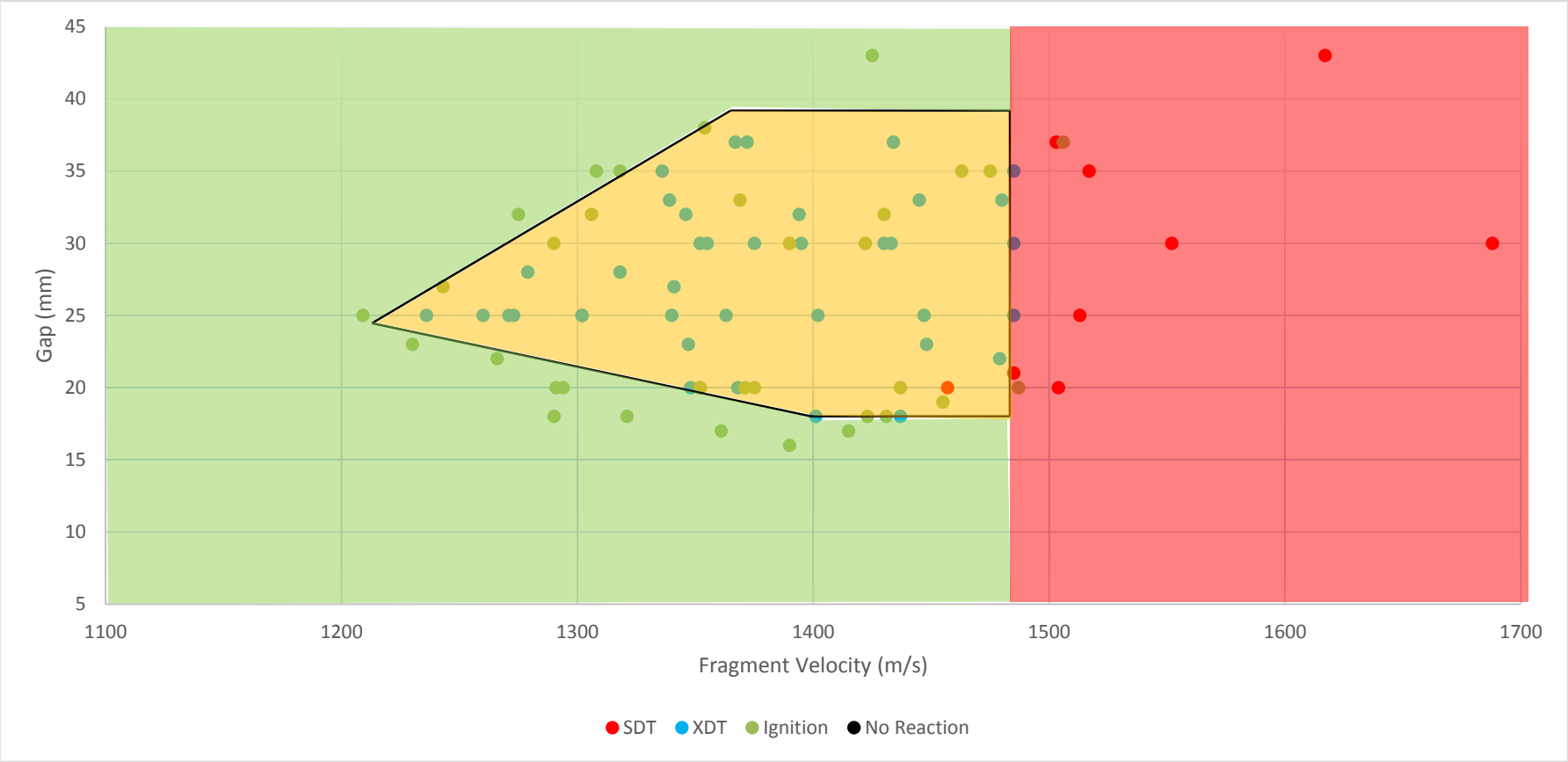
Trends?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Outliers


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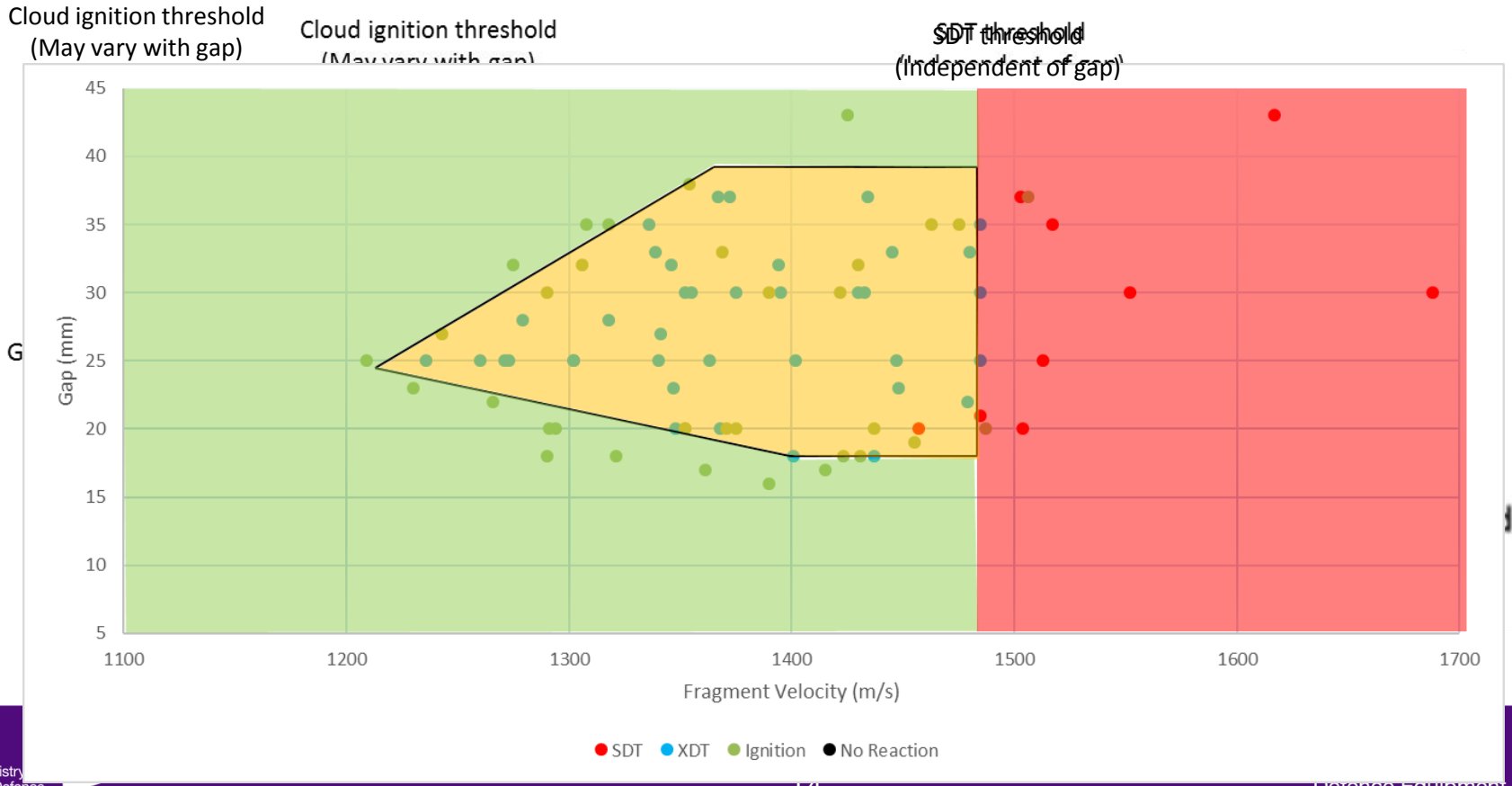
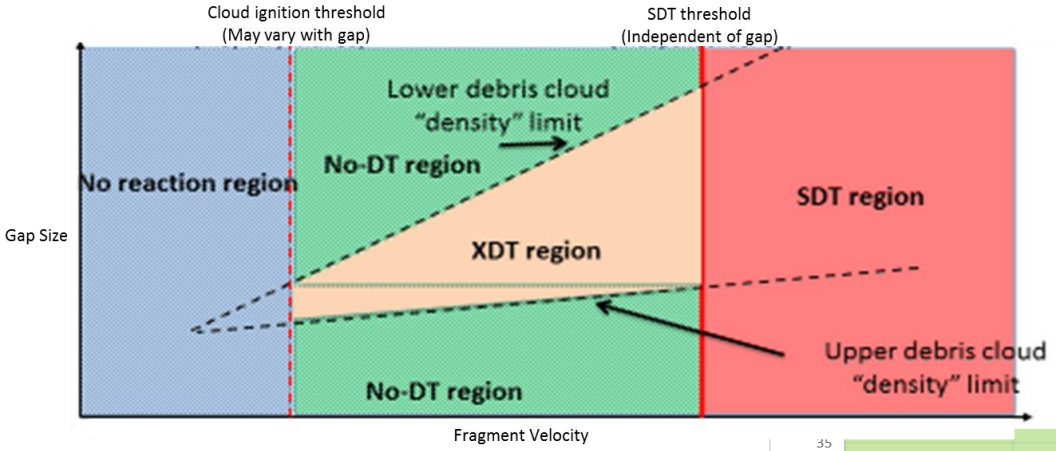
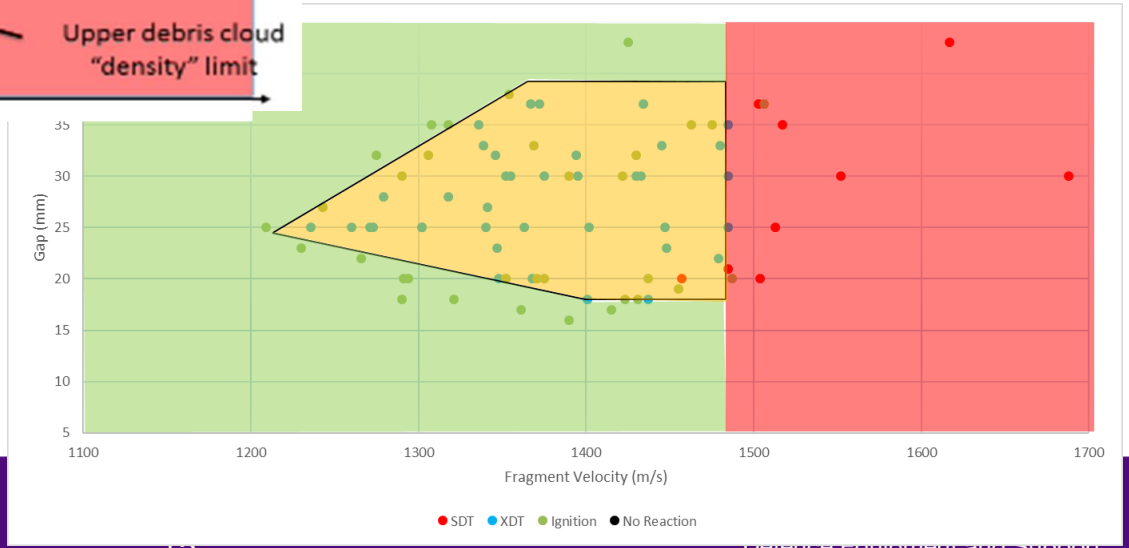
Hypothesis vs. Reality



Hypothesis vs. Reality





Conclusions

- There appears to be a trend similar to that previously hypothesised
- There are still outliers that cannot be explained
- More work is required to ‘fill in the gaps’
- This is just one material and so could have ‘got lucky’

Further Work

- Further trials to try to fill in the top right of the graph
- Other materials to investigate whether trend is consistent between materials
- Other material types e.g. propellants
- Try to model the phenomena and get consistency between experimental and model results

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Thank you for listening.

QUESTIONS