The Effect of Explosives Mitigation on A Shaped Charge Jet

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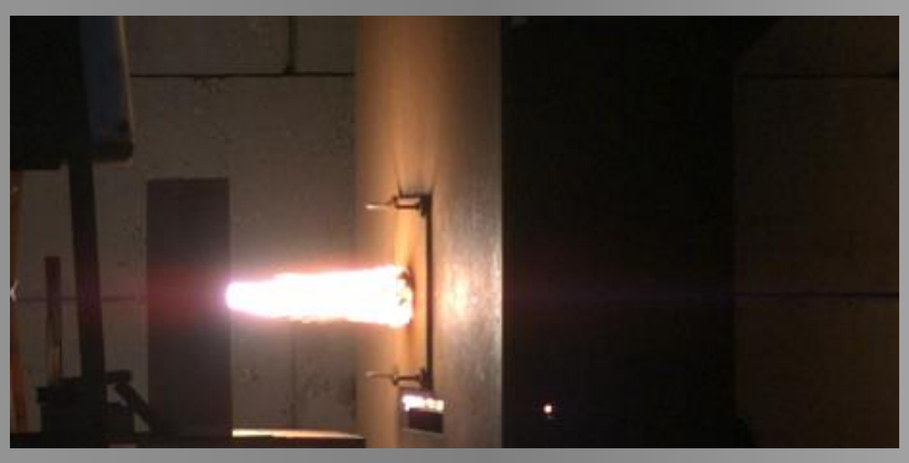
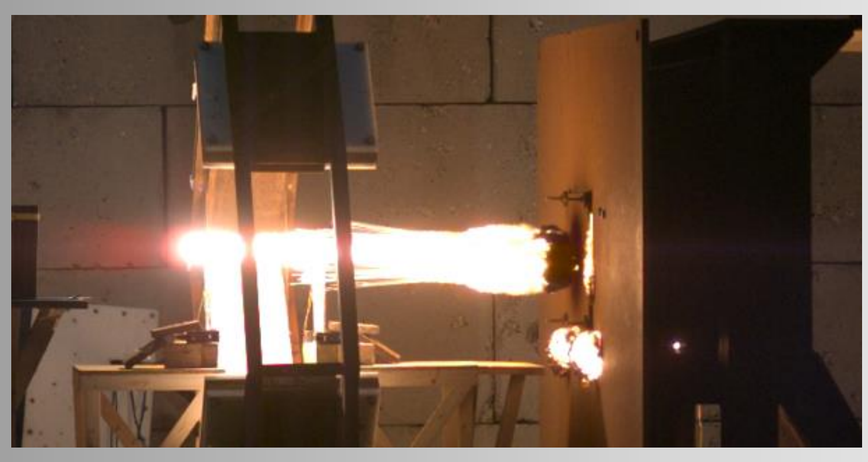



Project summary

What?

When a misfire scenario happens there is a need to dispose of a potentially damaged explosive charge, the process currently stands that the explosive will be isolated whilst a plan is implemented. The plan will usually involve applying a donor charge to detonate the trial and when mitigation is in place this will require disassembly of the trial furniture to gain access to the charge.

Why?

The project was implemented to combat the risk to staff when applying a donor charge to a potentially sensitised explosive. The act of disassembling trials furniture above or around such a hazardous item would mean an unacceptable level of risk if other options are available. This study was to apply shaped charges to this scenario in order to see the feasibility of success in a real life scenario and investigate what effect if any the mitigation would have on the shaped charge jet.

How?

A benchmarking trial was undertaken to confirm the viability of application to these scenarios and to confirm the data given by the supplier. These same systems were then applied to scenario that would be similar to the scenario described to assess the application and investigate the effect of mitigation schemes of the shaped charge jet.

Results

Figure 1 Aldermaston shots was the benchmarking exercise to ensure the shaped charges would perform as expected under normal condition at optimum stand off. The table below demonstrates what would be expected from the Monroe effect providing approximately 3 - 4 timed cone diameter depth of penetration for the Vulcans and over 4 cone diameters depth of penetration for the Pluton.

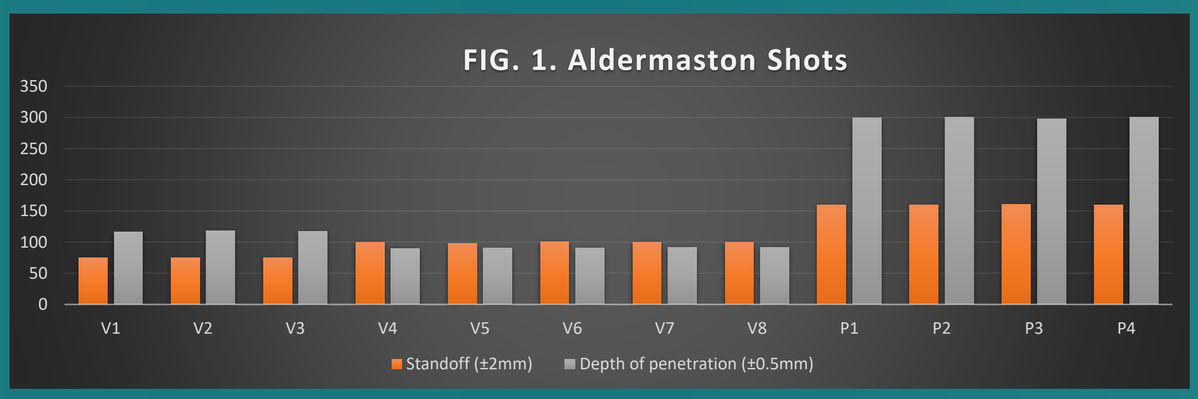
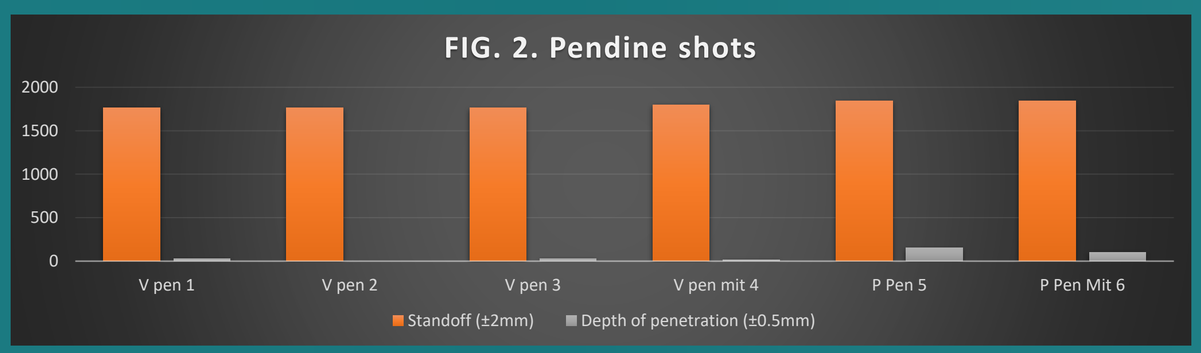
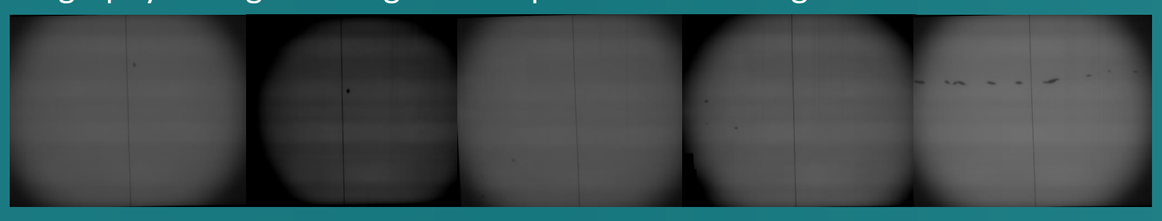


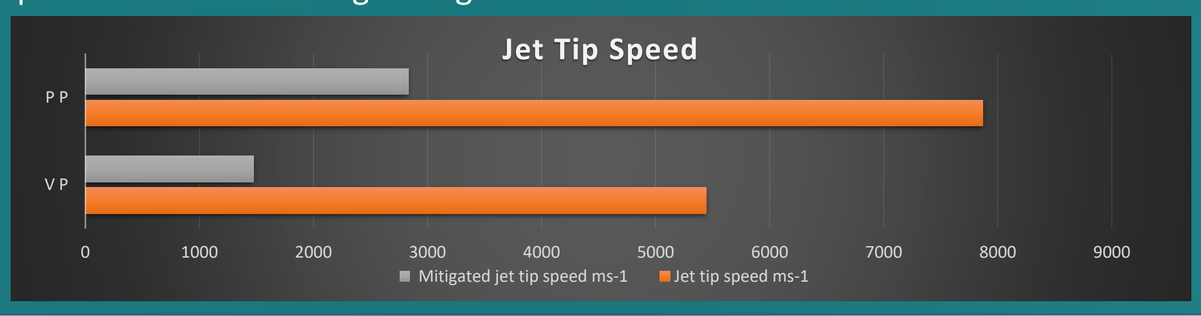
Figure 2 Pendine shots was the application of Vulcan and pluton shaped charges to a misfire. Distance played a considerable part in the effectiveness of the jet and its depth of penetration. There was a comparator to look at the difference between mitigated and unmitigated shots but the dataset was insufficient.



Radiography – during the Pendine trials issues were experienced with radiography timing meaning the comparative modelling was not undertaken.



A **Jet Tip Speed** reduction was observed when firing through mitigation of approximately 70% ±5%. This demonstrated a proportional reduction in jet speed when fired through mitigation.



Conclusions

In the appropriate scenario using a shaped charge to initiate charge is credible but account must be taken for the dramatic reduction in the jet speed and depth of penetration. The variation in the relatively small data set meant further assessment would be needed.

Further work

As mentioned further work to assess the viability of shaped charges would be needed to endorse the results found during the project.
The distance travelled has a significant effect to the depth of penetration and so viability of an explosively formed projectile would be the next step to investigating potential solutions to a misfire scenario.

Reflection

During the course of this project the author experienced some major personal difficulties resulting in loss of time and the inability to field further shots or computer modelling.
Should the opportunity come to revisit this study there is an absolute requirement to ensure an adequate data set is used.
The additional time lost could have been used to reimplement adequate radiography triggered at a more suitable time and investigate a comparative Eularian/Lagrangian electronic model through Ansys. The differences in the output would allow for calculation to be made to the relative density of the mitigation boxes for the volume. This could have been used to endorse hydrocode for future modelling for trials fielding and misfire scenarios.

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C.E. Munroe (1888) effects of detonation of gun-cotton [Online] Available: https://www.google.co.uk/books/edition/The_American_Journal_of_Science/hlM7AQAAIAAJ?hl=en&gbpv=1&pg=PA48&printsec=frontcover
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