An Assessment of the Response of Explosive Components to Shock Initiation

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Contents

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1 Background

Insensitive munitions (IM) improve the survivability of both weapons and their associated platforms from accident or enemy action

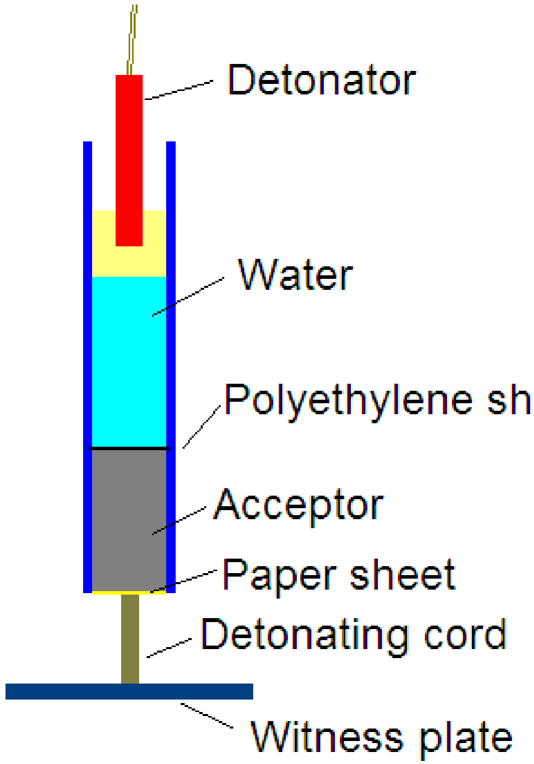
In addition to the main charge, each sub-system in the weapon, including the lead, booster and explosive train must be insensitive

STANAG 4187 requires the explosives and/or explosive compositions to be assessed and qualified in their design role in accordance with STANAG 4170 and the explosive train components to be evaluated in accordance with the requirements of STANAG 4363

AOP 21describes the Explosive Component Water Gap Test (ECWGT), which is, is used to evaluate the shock sensitiveness of a filled explosive train component

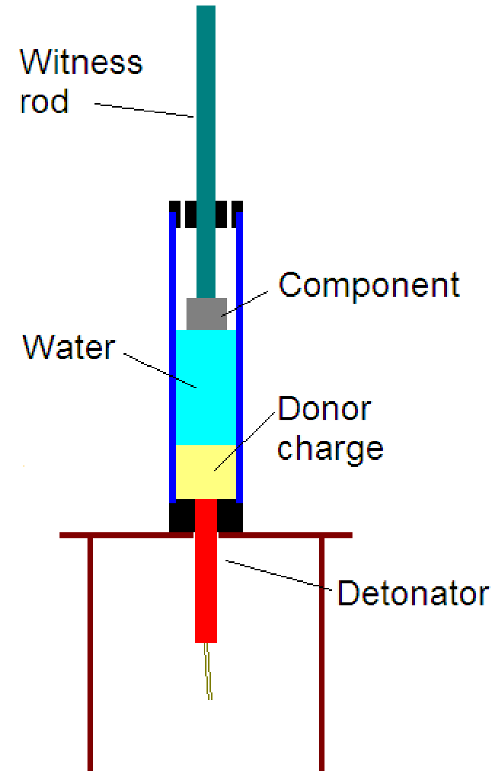
1 Water Gap Tests

Explosive Component Water Gap Test



AOP 21 and STANAG 4363
(Range of experiments)

Small Scale Water Gap Test



STANAG 4488

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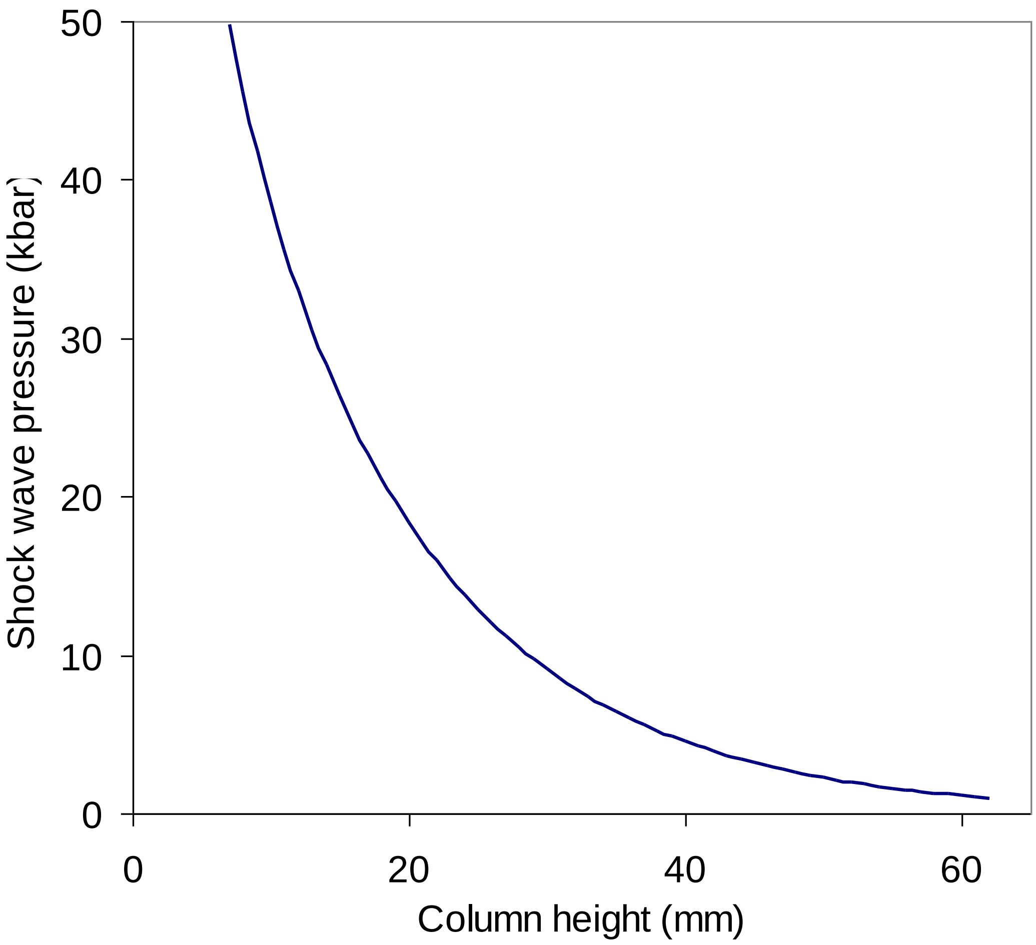
1 Water Gap Tests



Identical origin - R Wild 1978

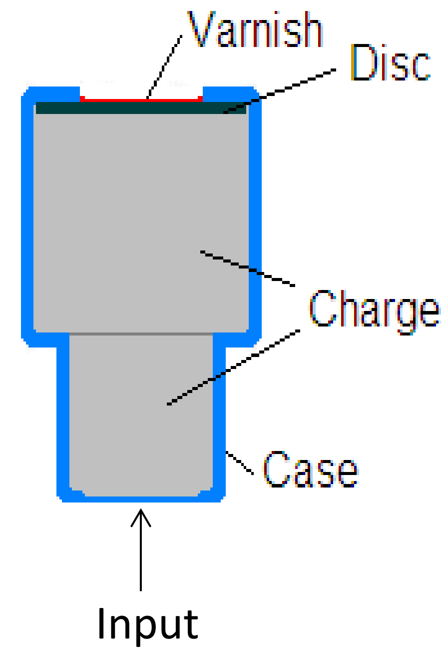
- Time taken for the shock wave to pass through the column of water
- Pressure probe and short circuiting switch
- Interpolation and Hugoniots

2 Round Robin Study – UK Results (8 full tests)

Comparison of:

DNAG No 8 with ICI No 3 detonator - No significant difference

Flat and cavity pellets - No significant difference



2 Round Robin Study – UK Results (8 full tests)

Comparison of:

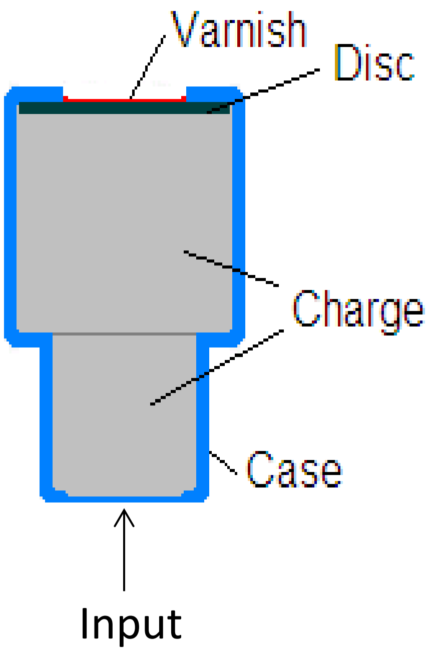
Tetryl v PETN in DM 1291 - 21.5 mm v 27.4 mm

PETN input v output end - 31.3 mm v 27.4 mm

Reproducibility PETN - 27.2 mm v 27.6 mm

PETN - 31.3 mm v 31.3 mm

Tetryl - 21.4 mm v 21.5 mm



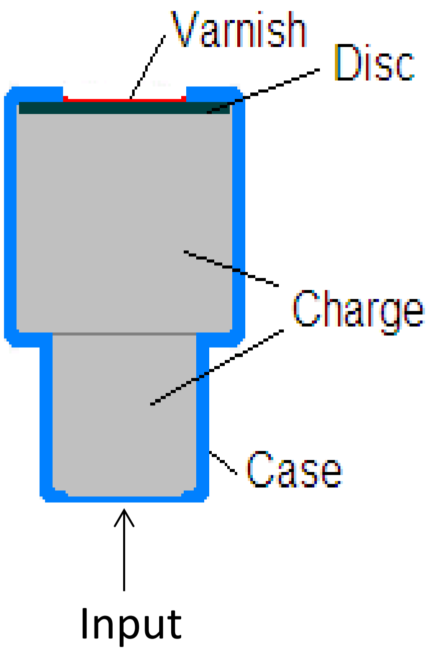
2 Round Robin Study – UK Results (8 full tests)

Comparison of:

PETN displaced from centre line - 28.8 mm v 31.3 mm

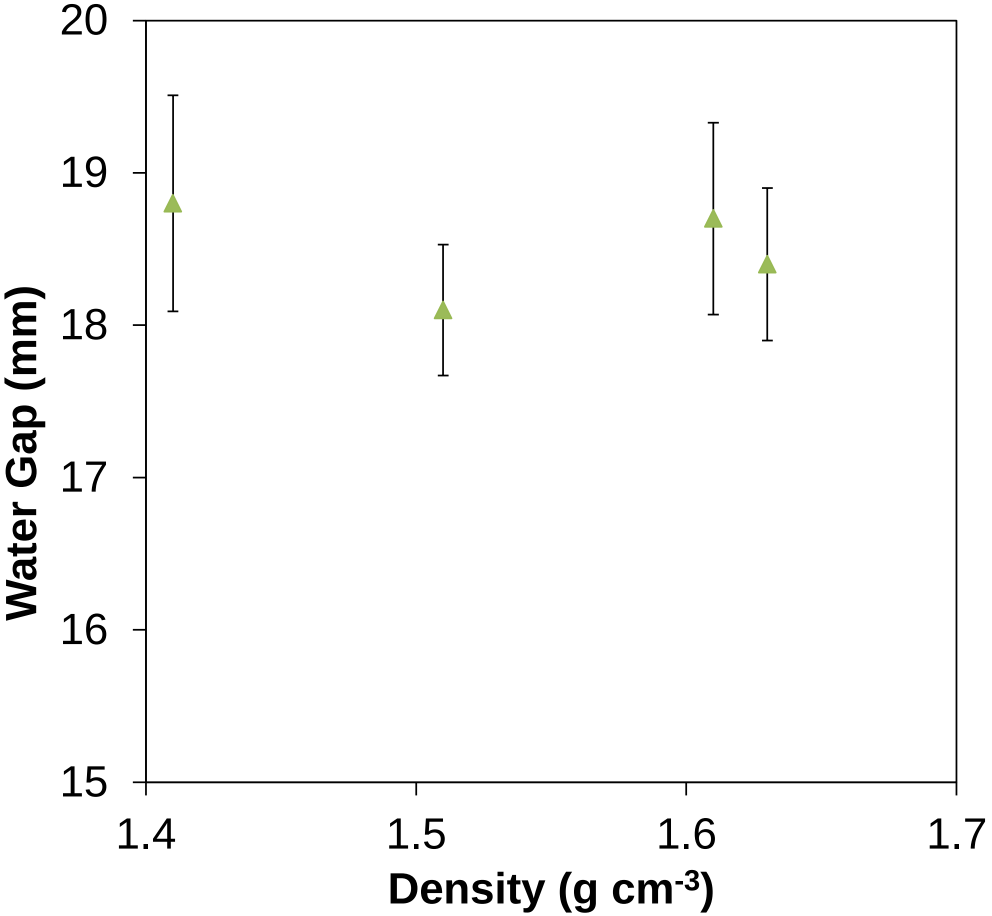
- larger sd 1.0 v 0.4

Submerging component 20.9 mm v 21.5 mm



3 Studies on Tetryl

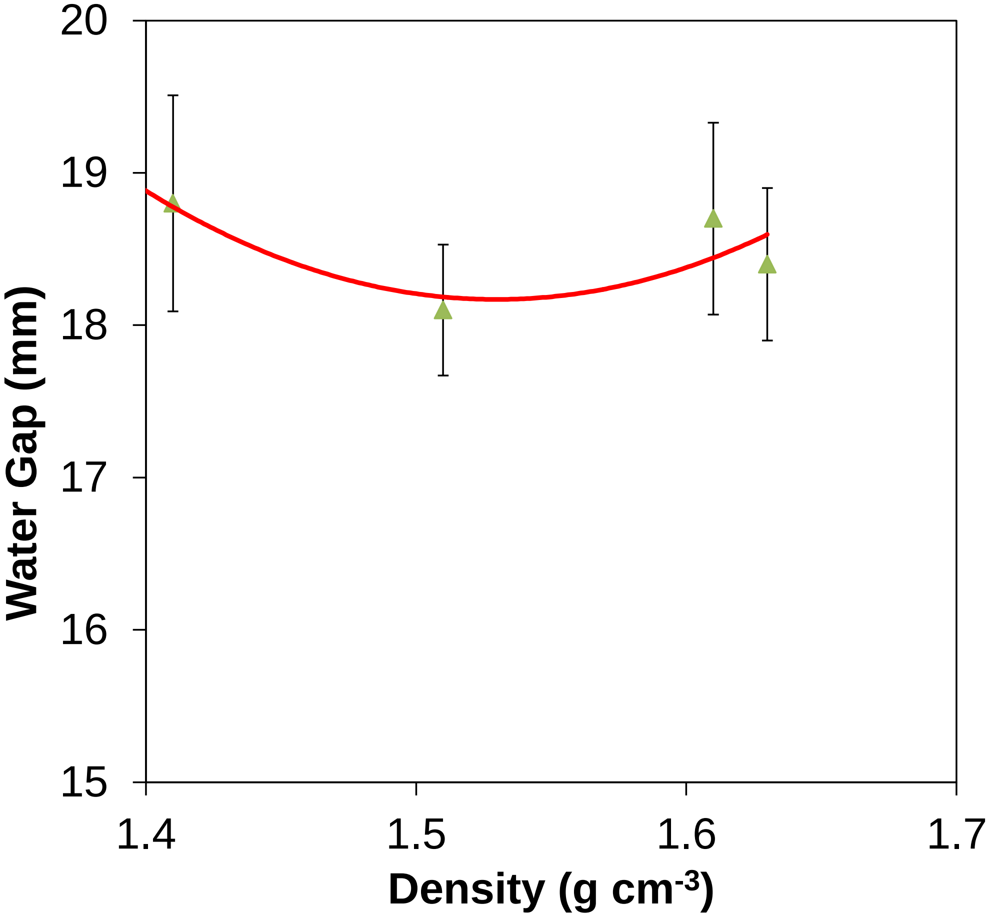
Water gap as a function of tetryl density



The water gap is considerably below the 28 mm acceptance level this reflects that the material is not confined

3 Studies on Tetryl

Water gap as a function of tetryl density



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3 Studies on Tetryl

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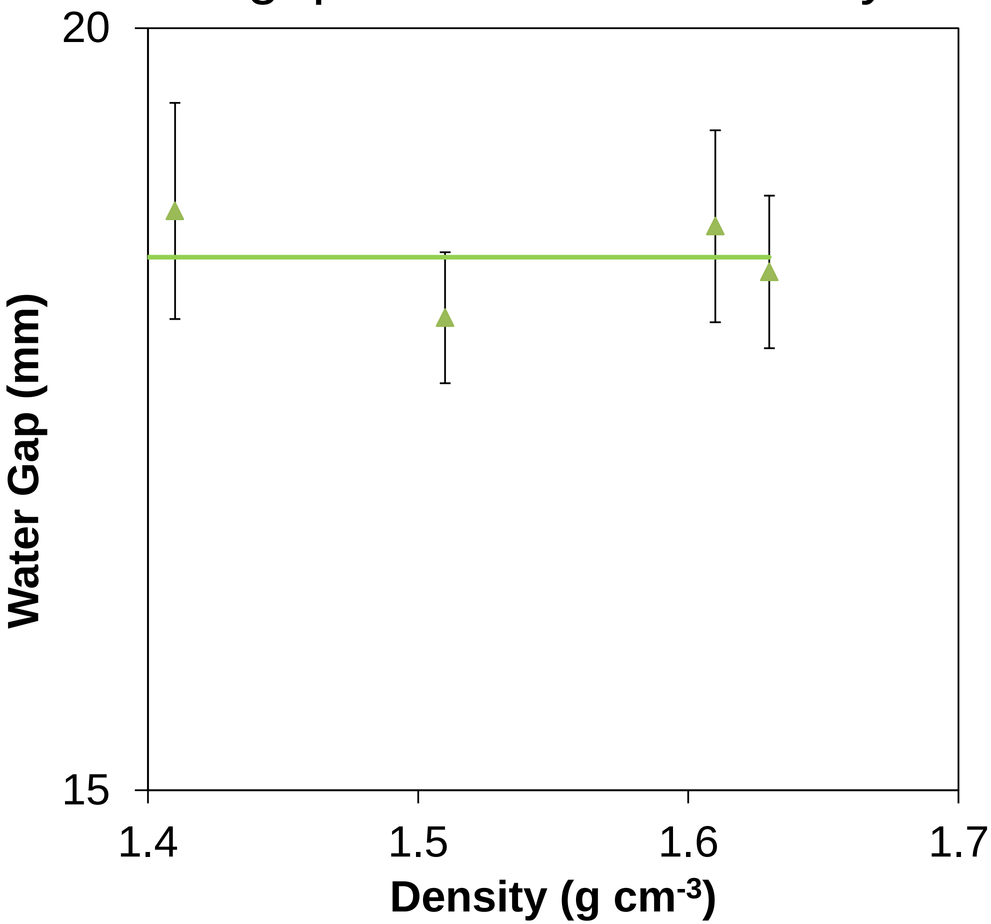


The water gap is considerably below the 28 mm acceptance level this reflects that the material is not confined

Over the range studied there was no significant difference in the shock sensitiveness

3 Studies on Tetryl

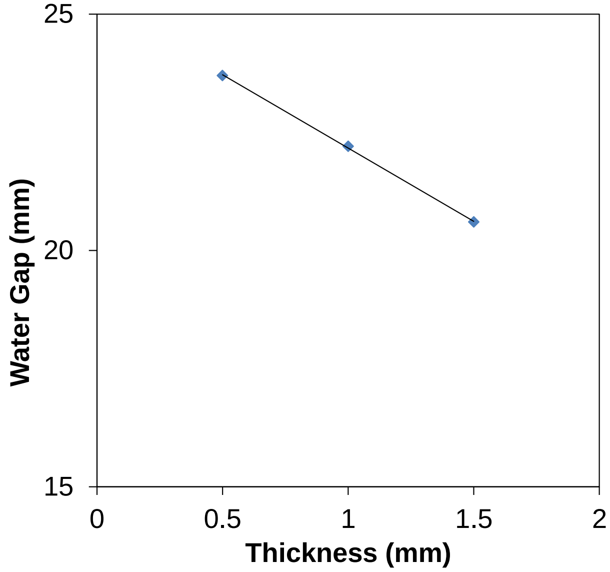
Water gap as a function of pellet size

Pellet diameter (mm)				
3.5	5	8	10	12
Water gap (mm)				
17.5	18.4	22.3 21.5	22.9	22.5 22.6

3 Studies on Tetryl

Water gap as a function of end cap thickness

End cap thickness (mm)	0	0.5	1.0	1.5
Water gap (mm)	30.1	23.7	22.2	20.6

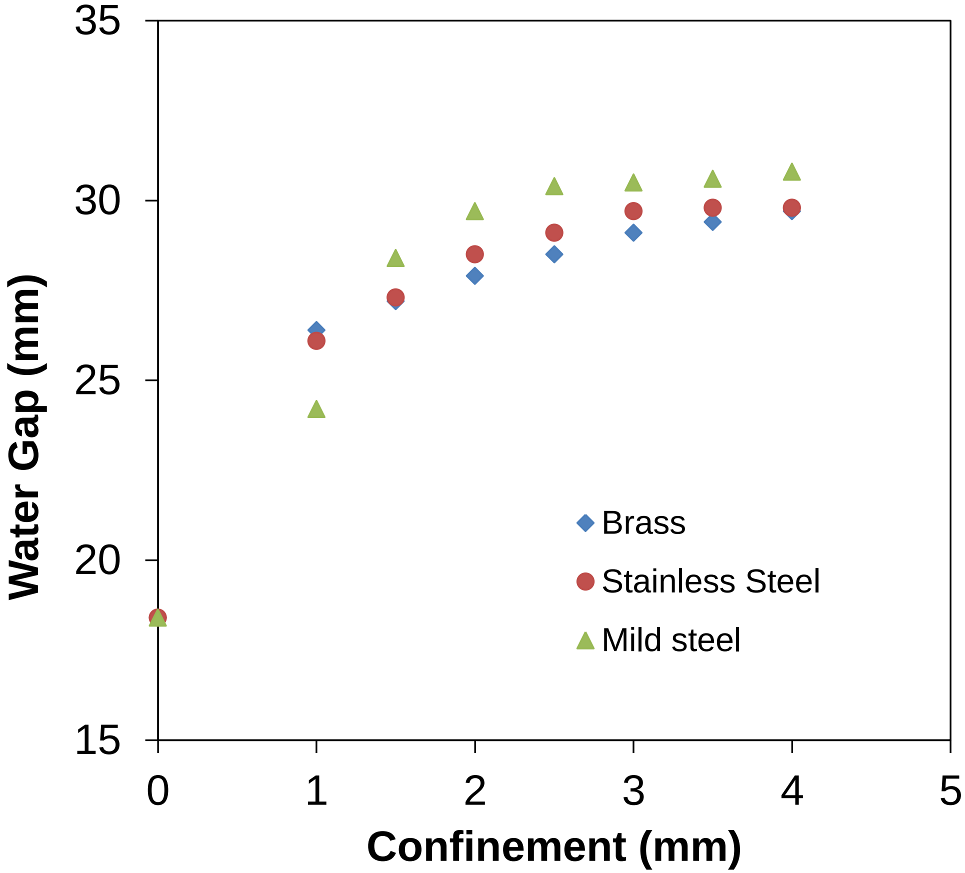


Attenuation of the incident shock wave and as the end cap thickness increased

Linear decrease over the range 0.5 mm to 1.5 mm

3 Studies on Tetryl

Water gap as a function of confinement material

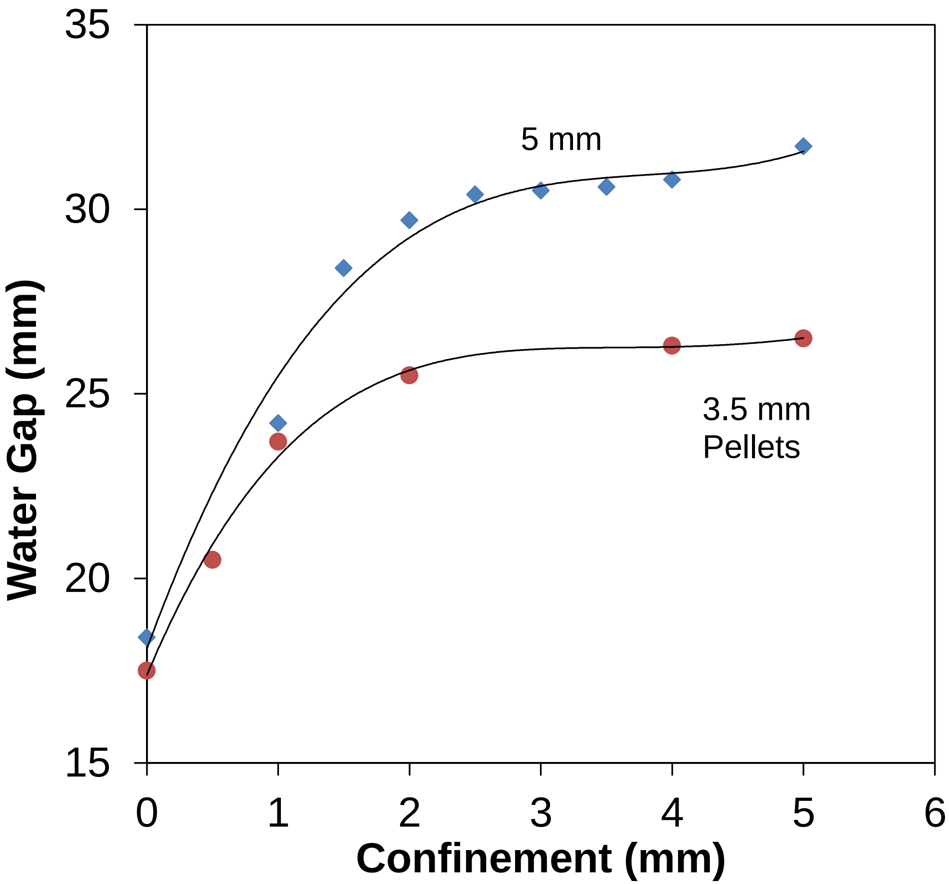


Initial increase in the water gap as the confinement increased

Above 3 mm confinement the water gap was essentially unchanged

3 Studies on Tetryl

Water gap as a function of pellet size



Initial increase in the water gap as the confinement increased

Above 2 mm confinement the water gap was essentially unchanged

Pellet size has an influence on water gap

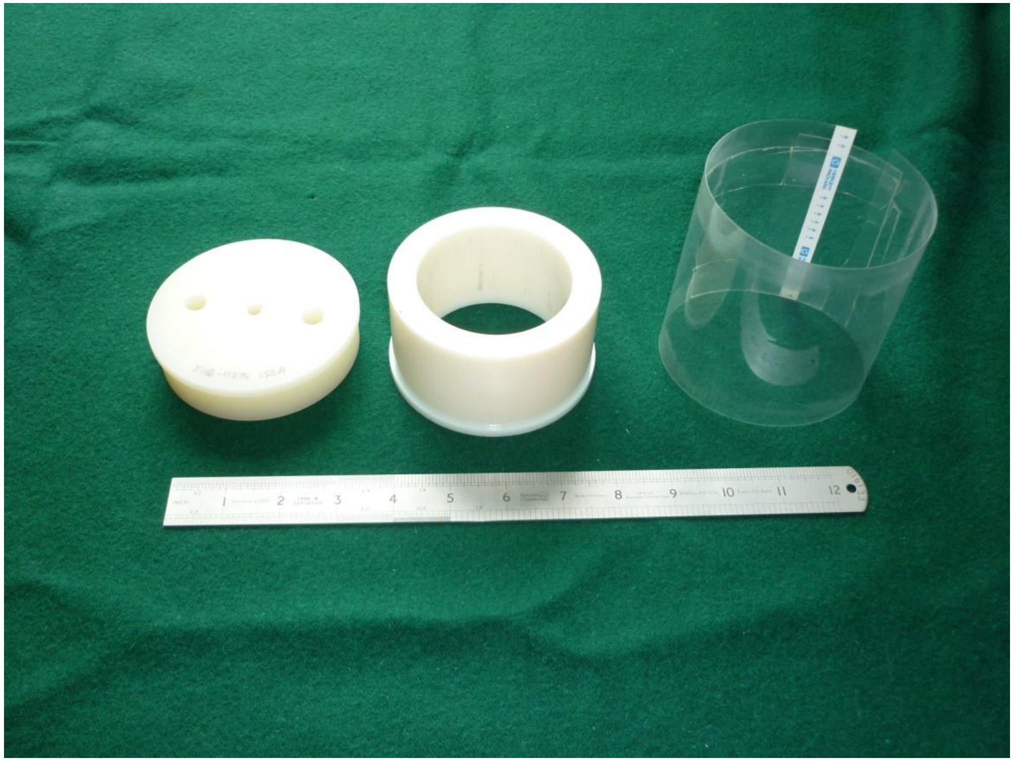
– Single results at 3.5 mm confinement for 5 and 8 mm pellets were similar

4 Recent Studies

Requirement:

To examine a component which was over 70 mm in diameter

4 Recent Studies



Retained donor charge size

Utilised a cellulose acetate sheet – easy to cut

Base to hold the component and provide a water tight seal

Too heavy to suspend from witness rod

- inverted test
- used a witness plate

4 Recent Studies

Go result

Water gap measurements were possible using the new test apparatus

Differentiating between a go and no-go was problematic but a solution was identified

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5 Conclusions

The introduction of AOP 21 and STANAG 4363 as an International standard involved technical contributions and experimental data from a large number of NATO nations, including the UK

Some of the data reported here enabled an improved understanding of the ECWGT results and helped in the development of new tests

The evolution of the ECWGT and an improved understanding of the test's limitations need to continue so that new designs of boosters, which are now much larger, can be assessed in the future

This can be achieved through further model development and additional experimentation

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6 Acknowledgements

The authors would like to acknowledge:

Sq. Ldr. David Nobel, Sq. Ldr. Bill Giles, Mark Wasko and Terry Jordan who performed many of the historical ECWGT experiments reported here

Phil Ottley, Barry Jenner, Steve Matthews, Matthew Williams who conducted the recent work