

# Measuring the Blast Output of Aluminized Explosive Charges in a Semi-Confined Environment

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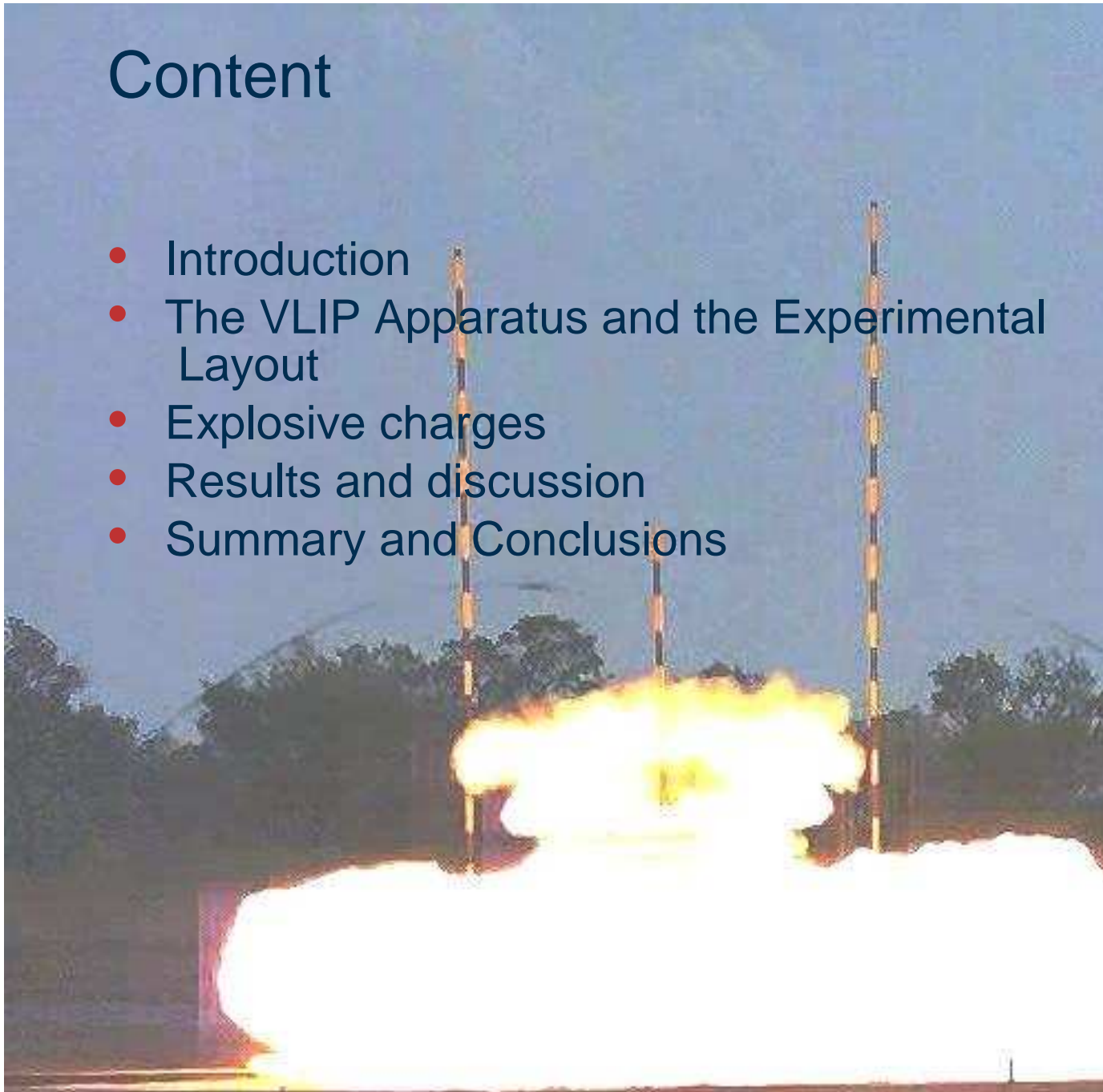
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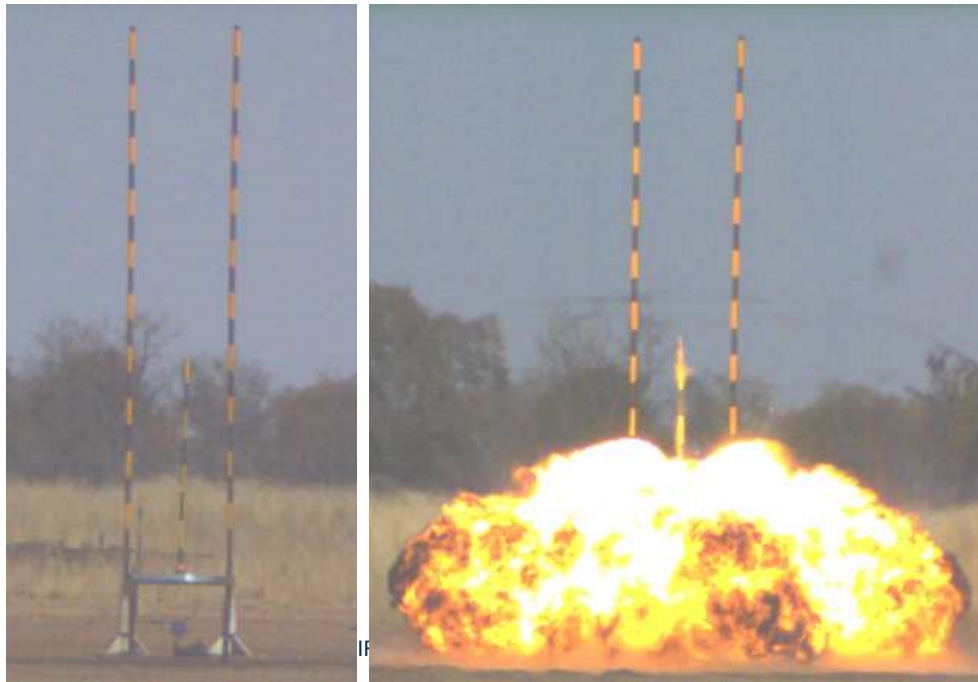
# Content

- Introduction
- The VLIP Apparatus and the Experimental Layout
- Explosive charges
- Results and discussion
- Summary and Conclusions



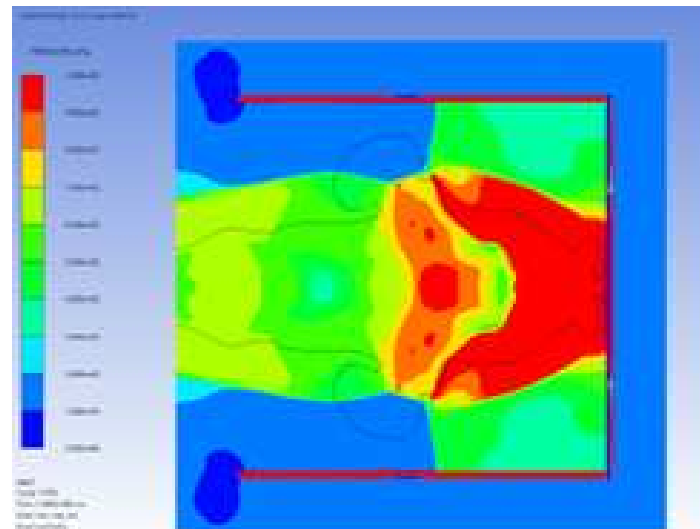
# Introduction

- Blast output of enhanced blast charges normally quantified by pressure measurement in confined enclosures
- Vertically Launched Impulse Plate (VLIP) used for landmine testing previously
- VLIP method not suited for enhanced blast charges



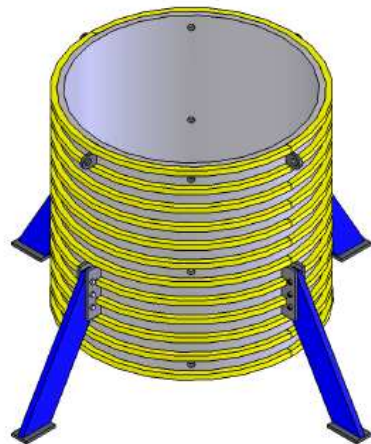
# Introduction and Objectives

- Initial objective – to research the effect of up to 3kg explosive charges
- Simulations showed that a very heavy structure is required for 3kg charges that was not affordable
- Requirement scaled down to 0-1kg charges
- Experience with pressure sensors in the fireball limited
- Decision made to design a semi-confined VLIP apparatus



# Design of the semi-confined VLIP

- Mild steel cylinder used 1.5m length  $L/D = 1$
- Hoops of mild steel used to strengthen the cylinder at approximately 100mm spacing intervals
- Cylinder suspended 300mm off the ground for venting
- Mast rigidly fixed on lid to monitor motion via camera
- Measuring ports around the circumference of the cylinder



# Design of the semi-confined VLIP

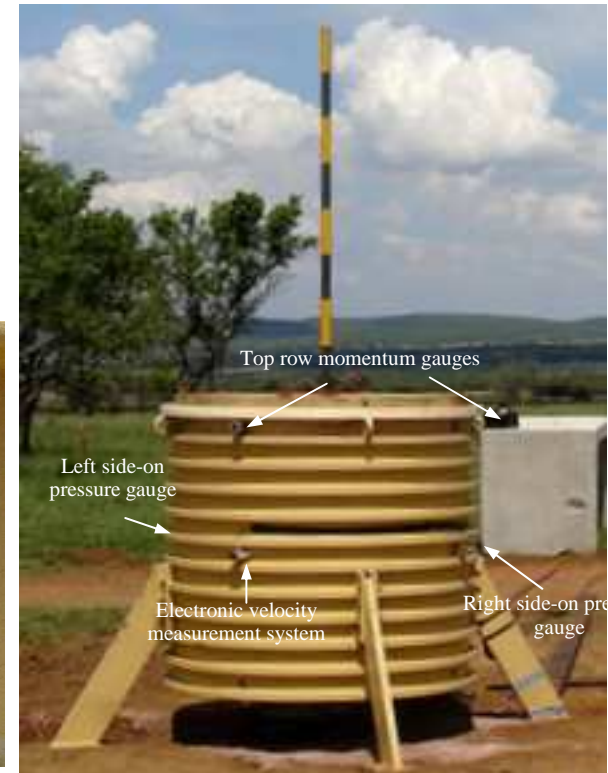
- Fixtures with heavy threads in ports for 'secondary' measurements
- Two PCB137 over-pressure sensors used in opposite ports
- PCB 109B sensor used initially – switched to Kulite 375-M for reflected (face-on) pressure measurement
- Momentum gauge with a laser velocity measurement system employed





# Design of the semi-confined VLIP

- Sensors and momentum gauges fixed in the VLIP apparatus



# Experimental Procedure (Photron Camera)

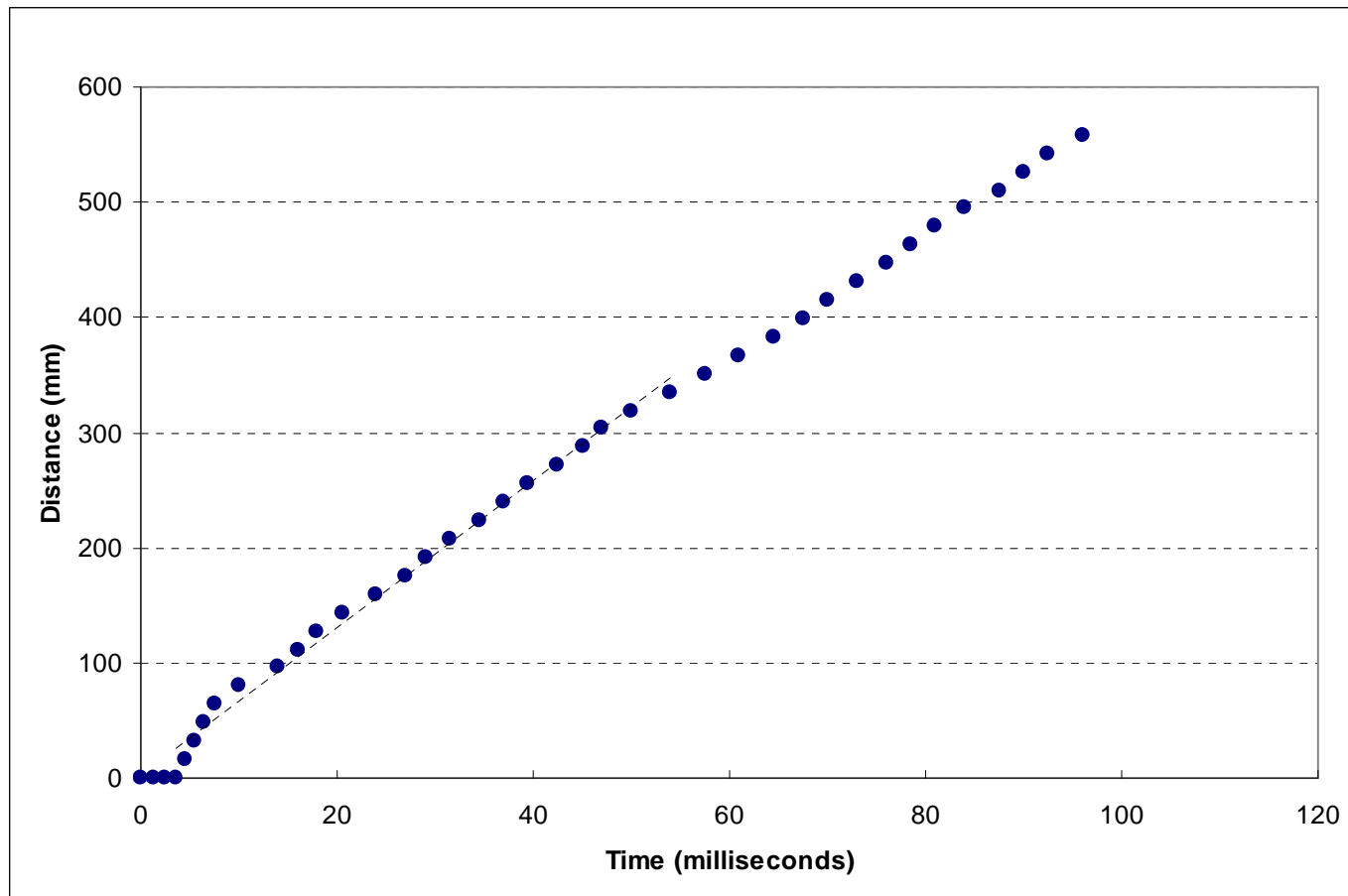


- 10000 fps



# Experimental Procedure

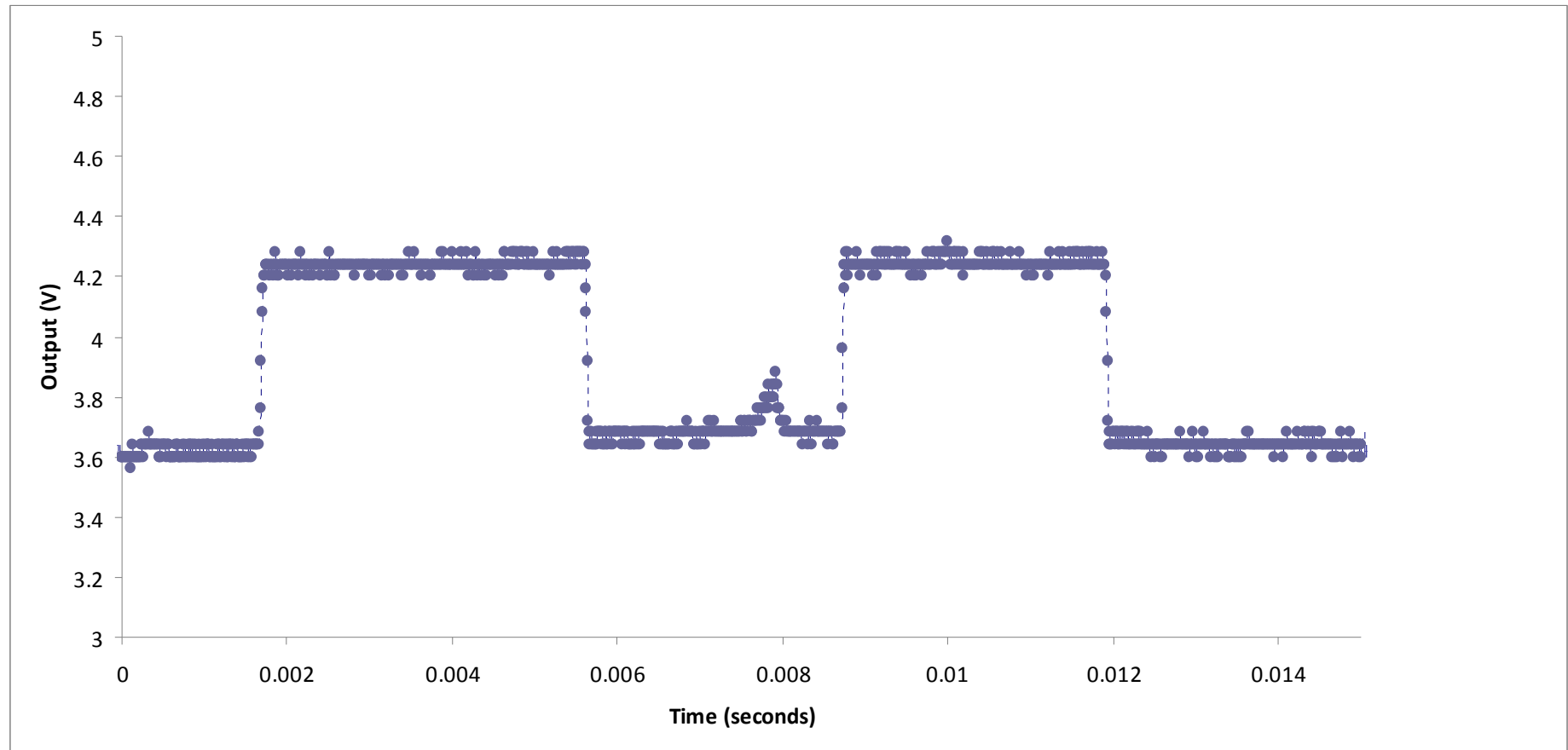
- Distance-time plot from the digital video recording



# Experimental Procedure

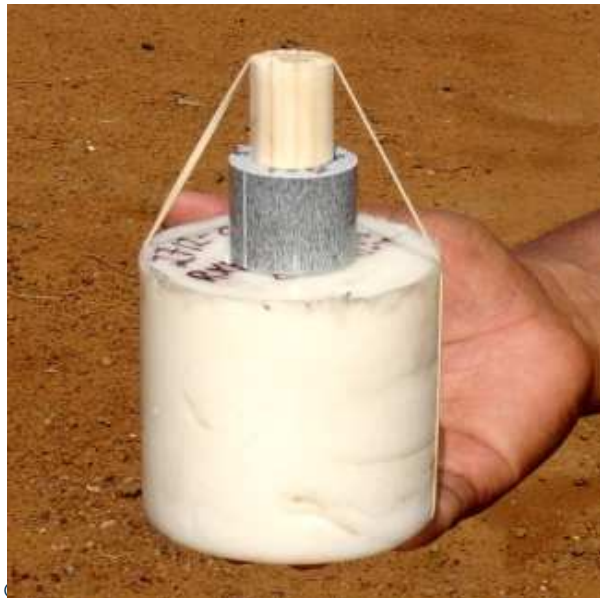
## Momentum Gauge

- Typical gauge recording



# Explosive Charges

- Two test series performed with RDM explosive charges
- Charges RDX based cast explosives, containing between 0-30%aluminium
- Charges hung from the lid in a wire cradle center to the VLIP apparatus
- Charges detonated in the downward direction



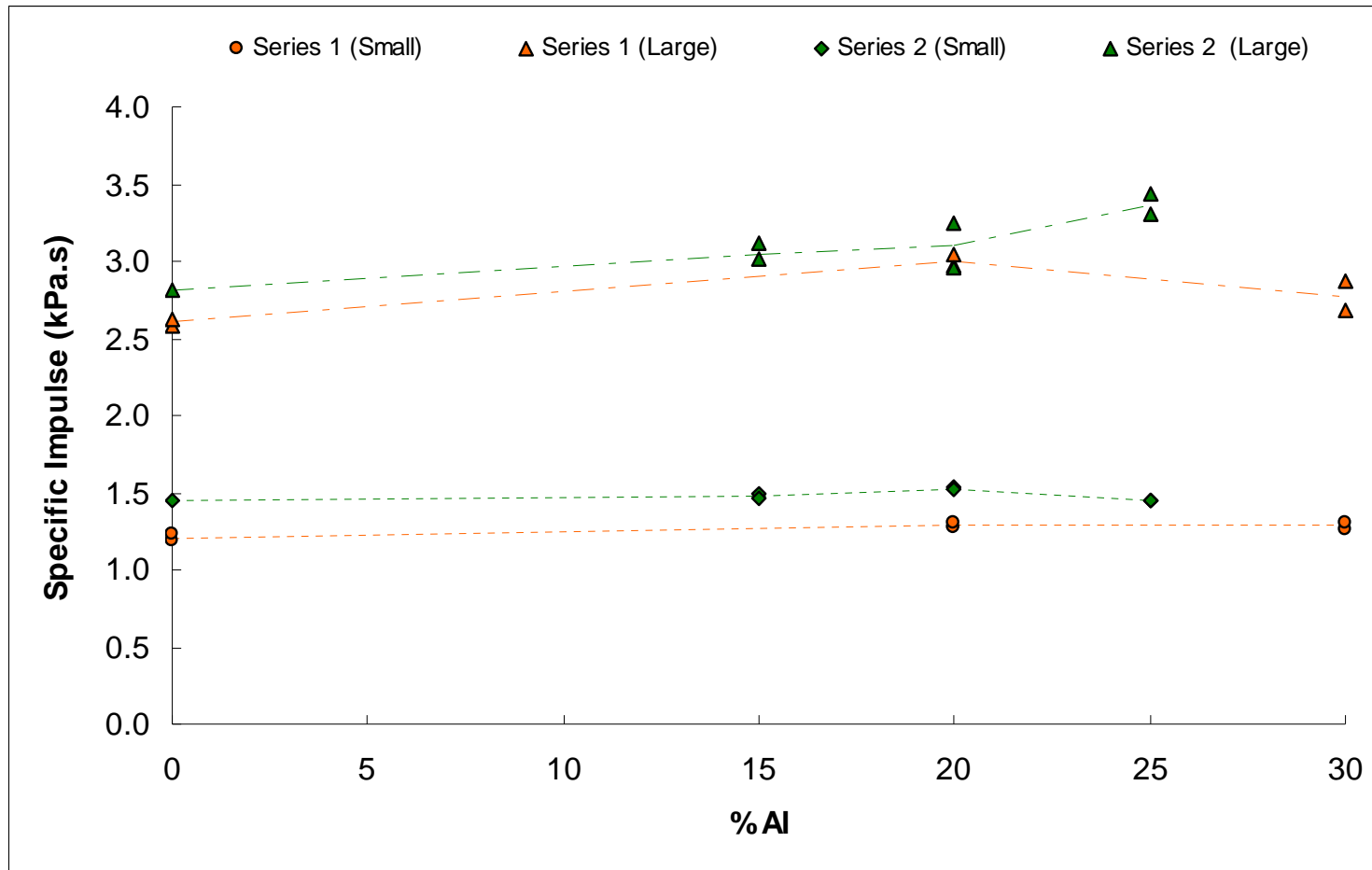
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# Explosive Charges

- 900g-1kg and 250-300g results for aluminised charges

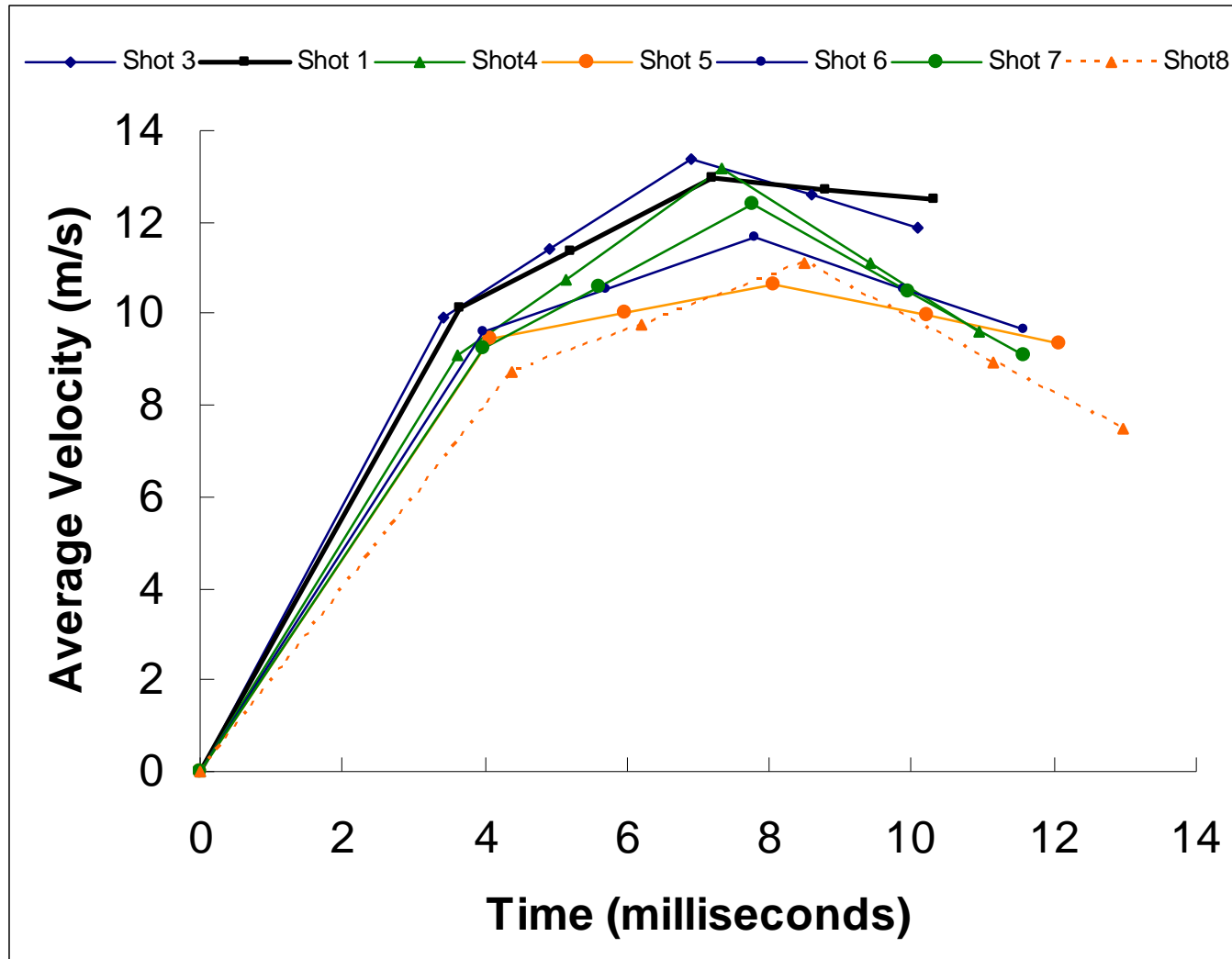
Series	Designation	Size	% Al	Density (g/cc)
Series 1	RXHT8403	Small	0	1.55-1.57
		Large		1.56-1.57
	RAHT6401	Small	20	1.65-1.67
		Large		1.67-1.68
	RAHT5401	Small	30	1.71-1.73
		Large		1.72-1.73
Series 2	RXHT8405	Small	0	1.57-1.58
		Large		1.57-1.59
	RAHT6901	Small	15	1.62-1.64
		Large		1.62-1.64
	RAHT6402	Small	20	1.66-1.67
		Large		1.65-1.67
	RAHT5901	Small	25	1.69-1.70
		Large		1.68-1.69

# Results

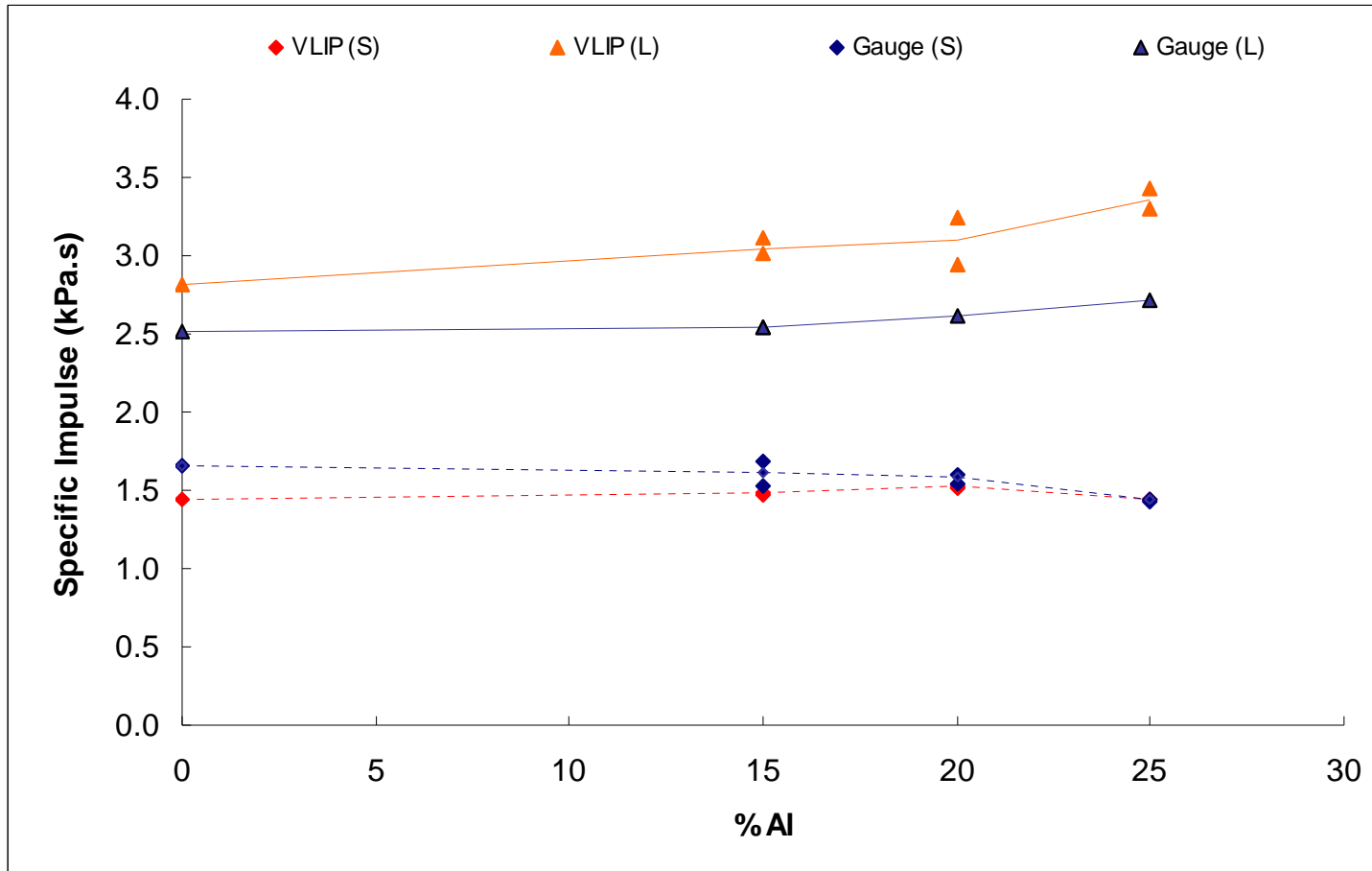




# Results

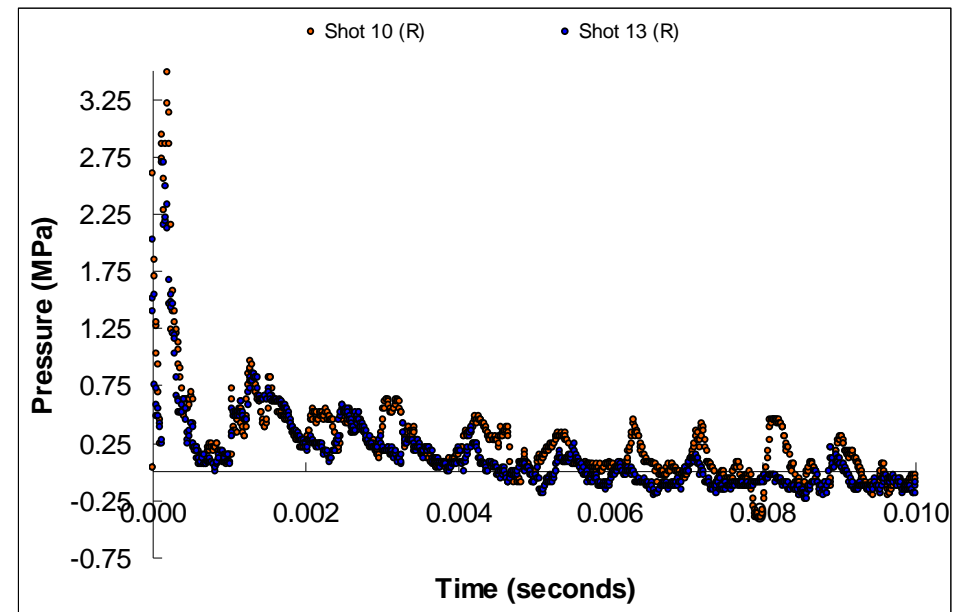
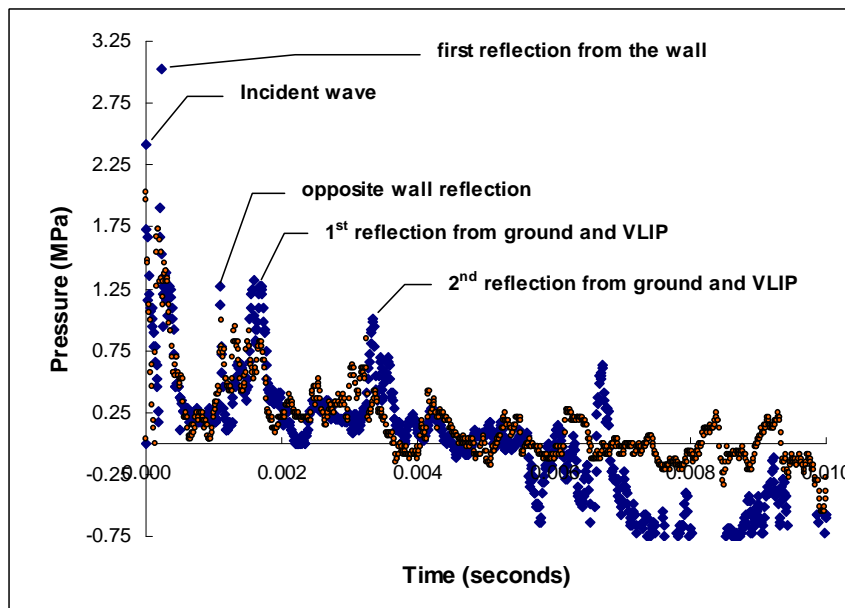
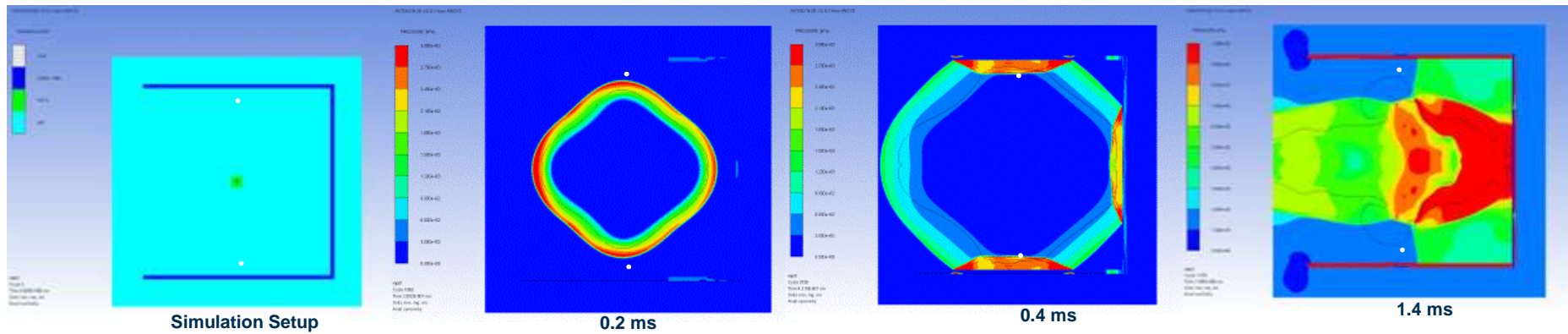


# Results



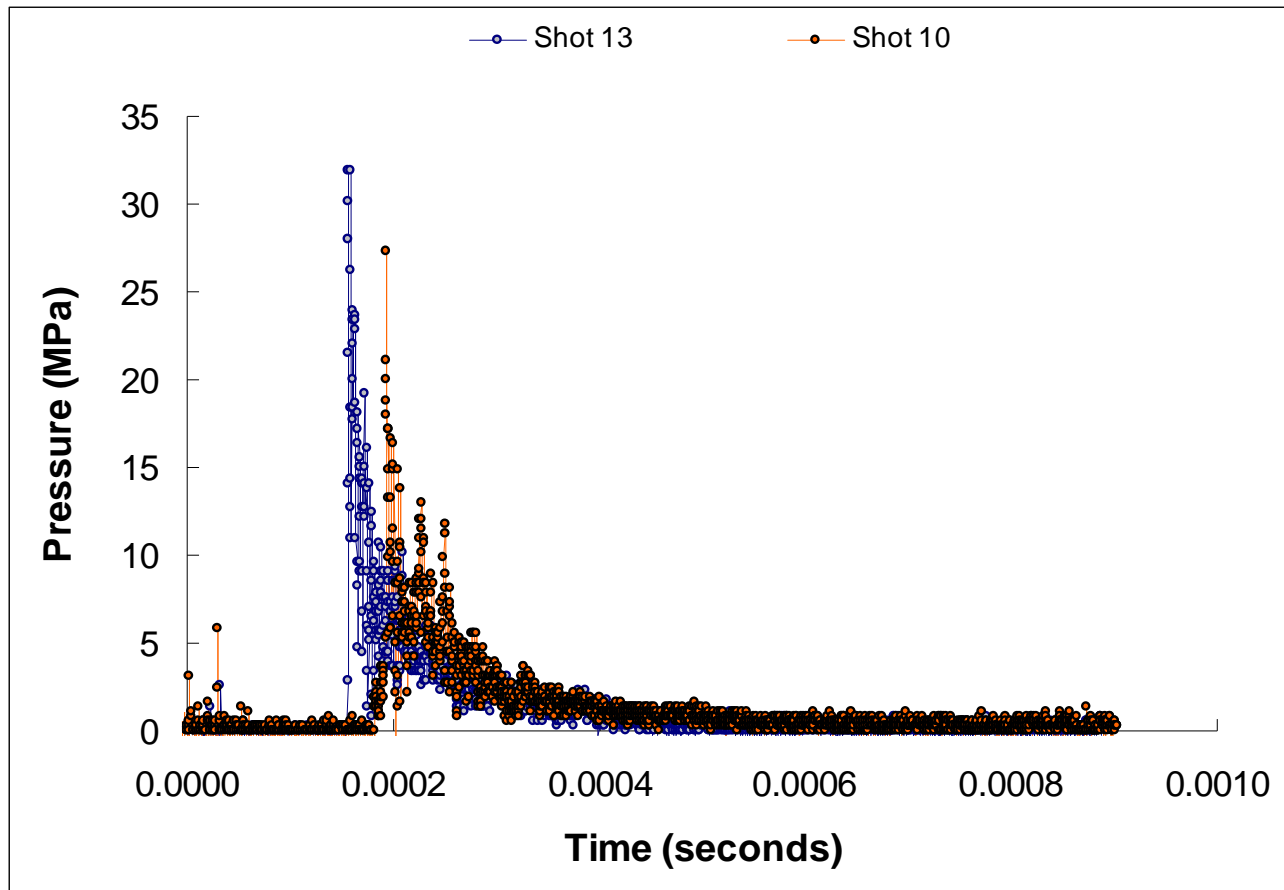
# Results

- Overpressure simulations and sensor recordings



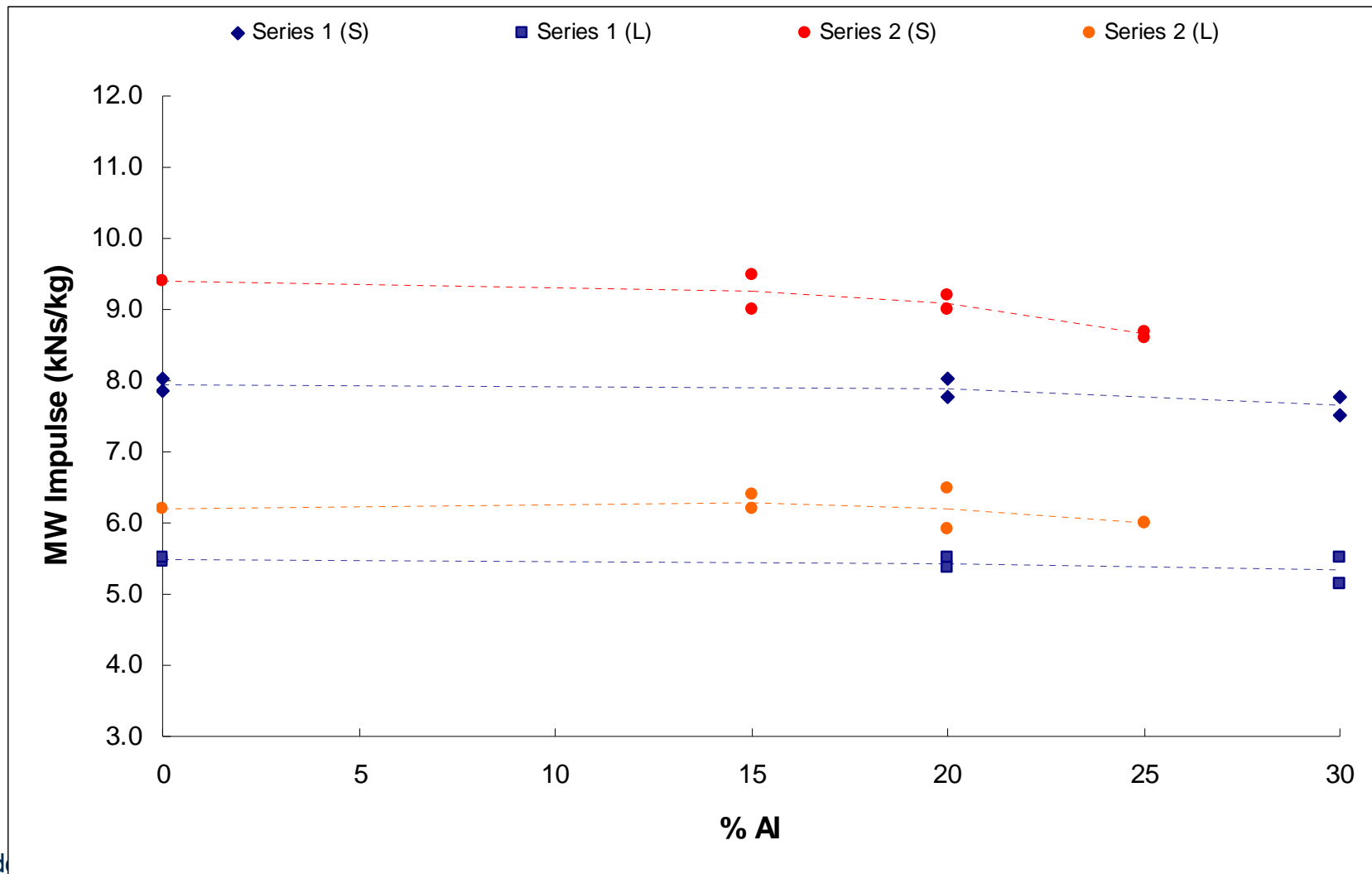
# Results

- Reflected pressure recording



# Results

- Mass weighted impulse





# Conclusions

- Semi-confined VLIP can be used as a ranking tool with sufficient resolution (average 4% variation between similar firings)
- Afterburning from aluminised charges observed and identified from the results
- Pressure sensor results consistent but need to be improved if to be useful for quantification of blast output
- Momentum gauge results consistent with VLIP results
- For the type of aluminised charges used :
  - Smaller charges (300g) show little improvement with increasing aluminium content
  - Larger charger (900g) exhibit significant afterburning behaviour
  - Mass weighted impulse not significantly better

**Photron**

10000 fps

End

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1/10000 sec

frame : -13327

512 x 512

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