Shock Desensitization Effect in the STANAG 4363 Confined Component Water Gap Test

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*Participating guest from DGA/CEG (Gramat)

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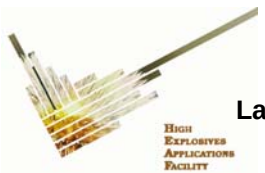


Overview (ECWGT)

Introduction

– Configurations

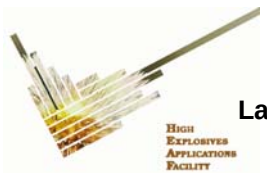
– Models

– Shock wave in water (time arrival, peak pressure)

– Go/No Go results

– Confinement influence on the Go results (Lagrangian pressure)

Conclusion

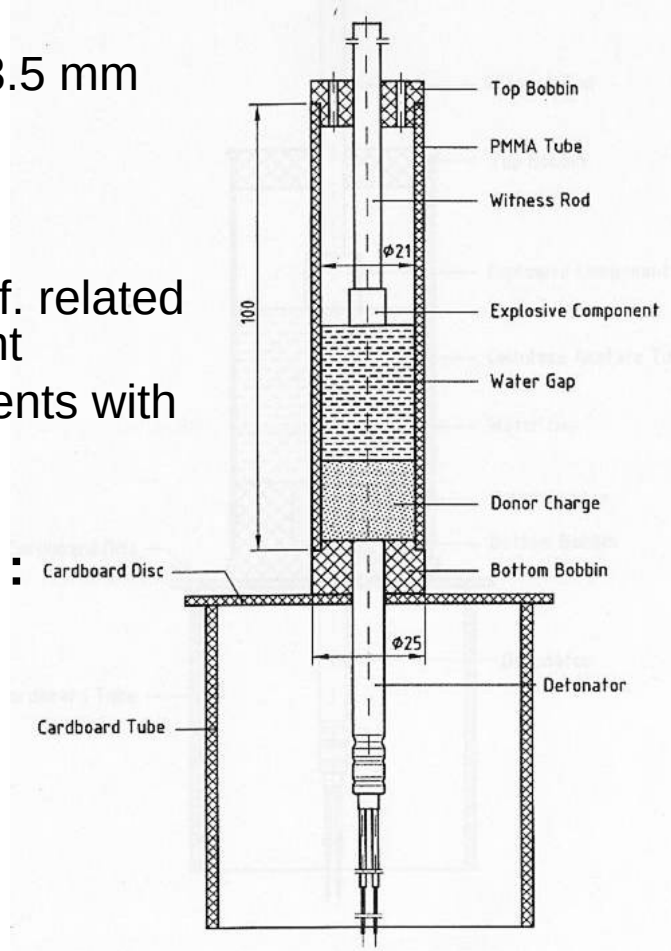


Explosive Component Water Gap Test (ECWGT)

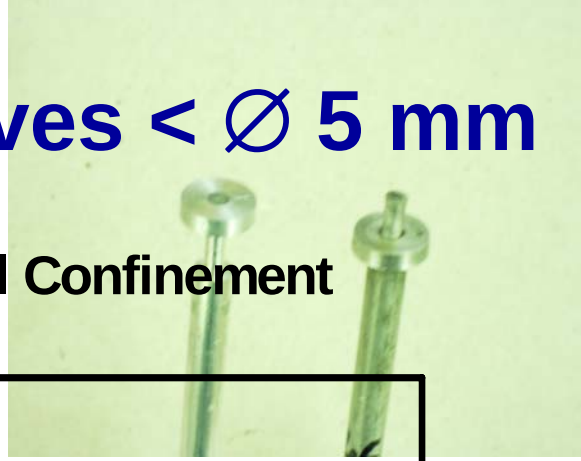
- **Experiments**
  - Defined by Stanag 4363 ed.3 final draft
  - performed by Wiweb and TNO
  - ∅ 3 mm PETN pellet with steel conf. 1mm, 2mm, 3.5 mm thick

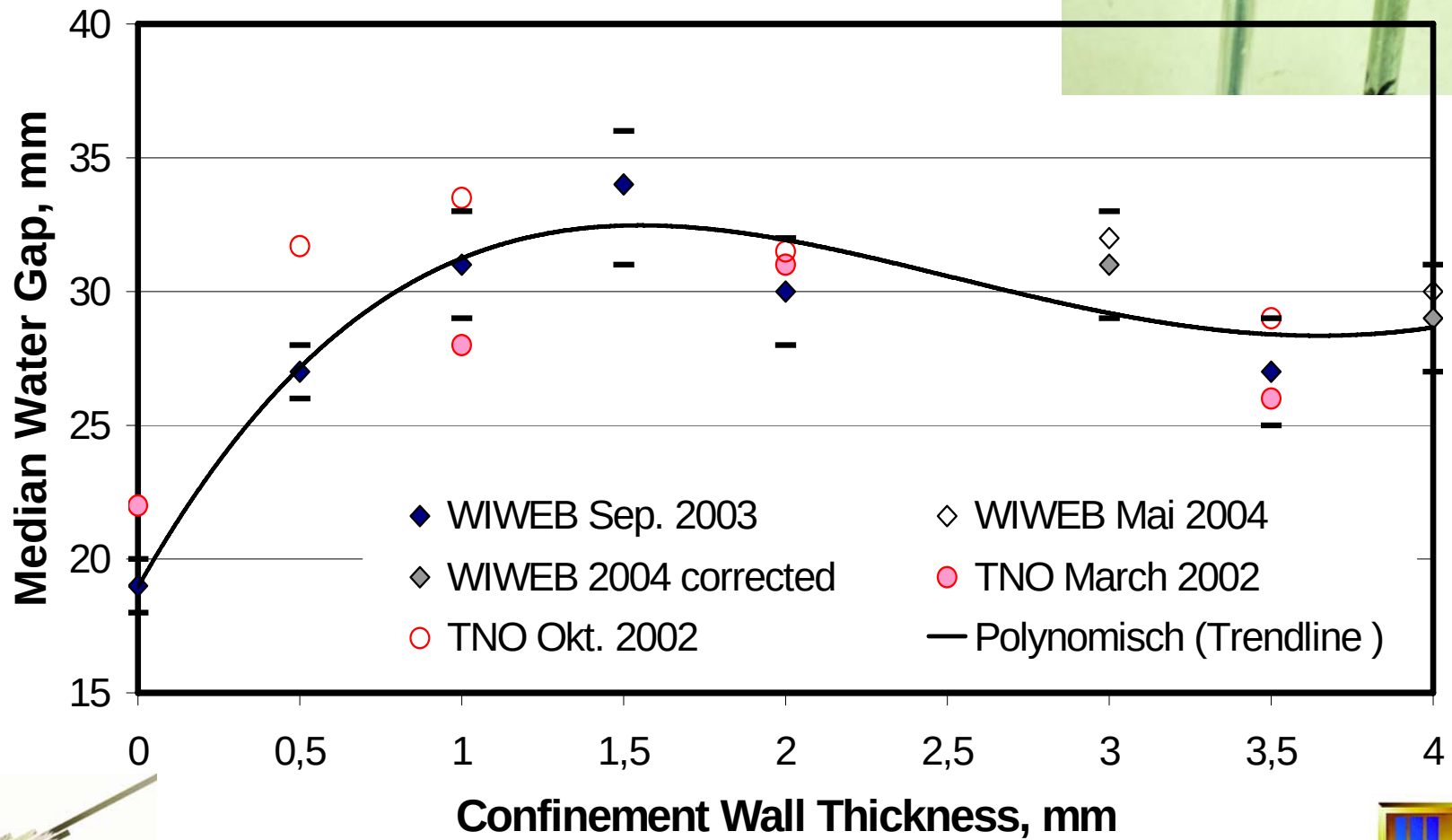
- **Goal :**
  - Trying to understand better the influence of the conf. related to the desensitization with 3.5 mm thick confinement
  - Update the Stanag 4363 ed.3 for confined components with explosive fills having a diameter less than 5 mm

- **This work, Ls-Dyna runs 2D axi and 3D wedge :**
  - Models, including Ignition and Growth
  - aluminum or steel annular confinement
  - target double height
  - half donor charge height and initiation type
  - PMMA confinement thicknesses (water column)
  - constitutive laws on go/no go threshold
  - glue between Pellet and witness rod

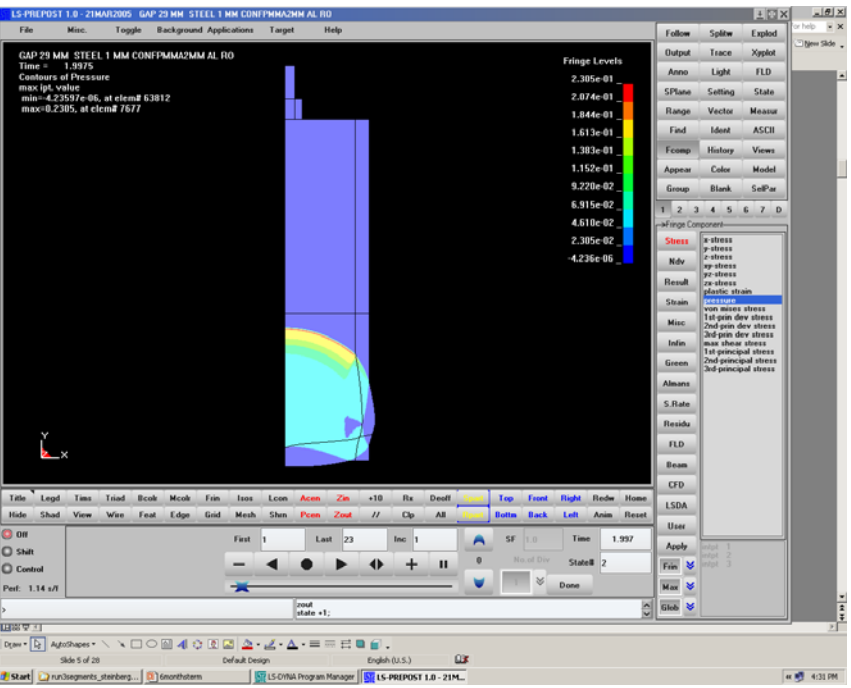


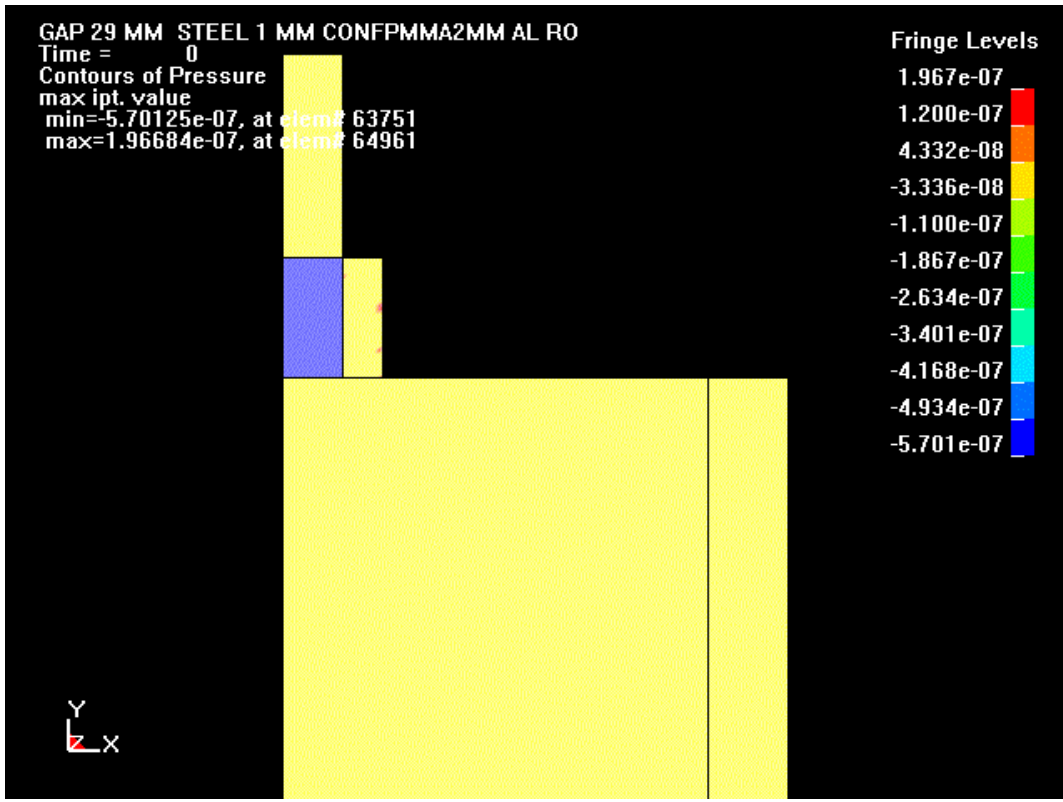
Special Effect for Small Explosives < ∅ 5 mm



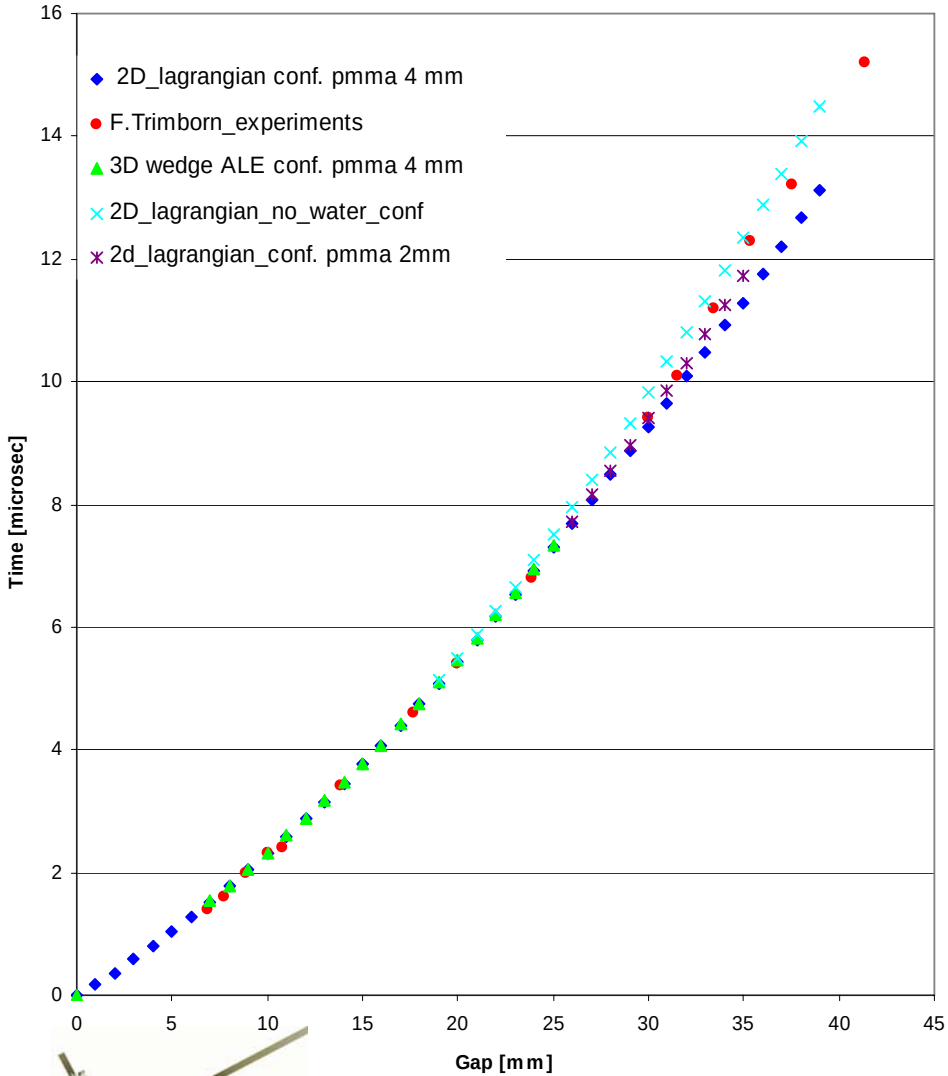


Configurations - Models (ECWGT)



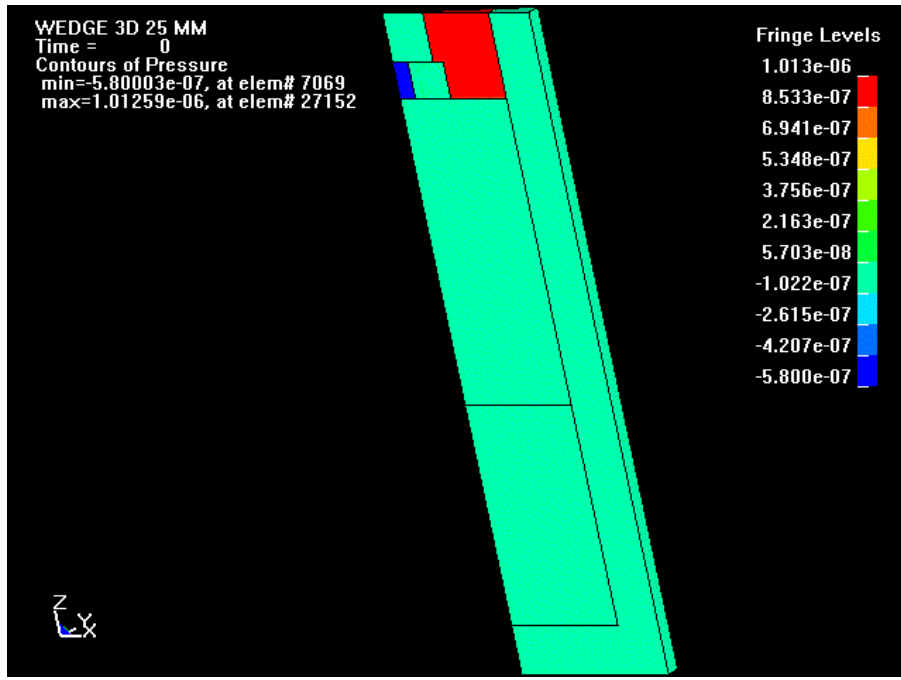


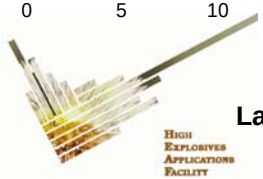
Water shock wave (ECWGT)



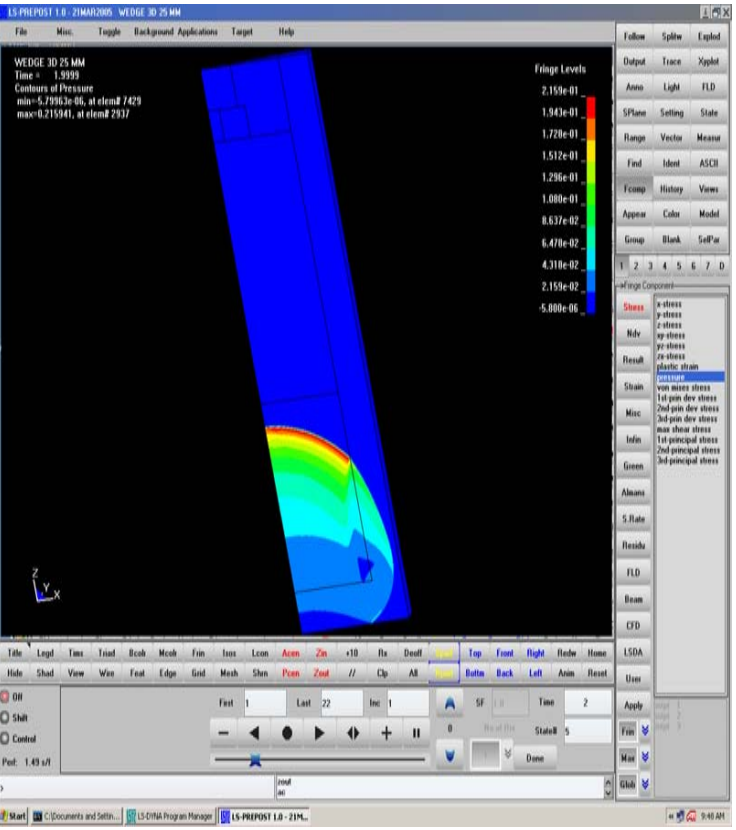
Time arrival versus distance in water :

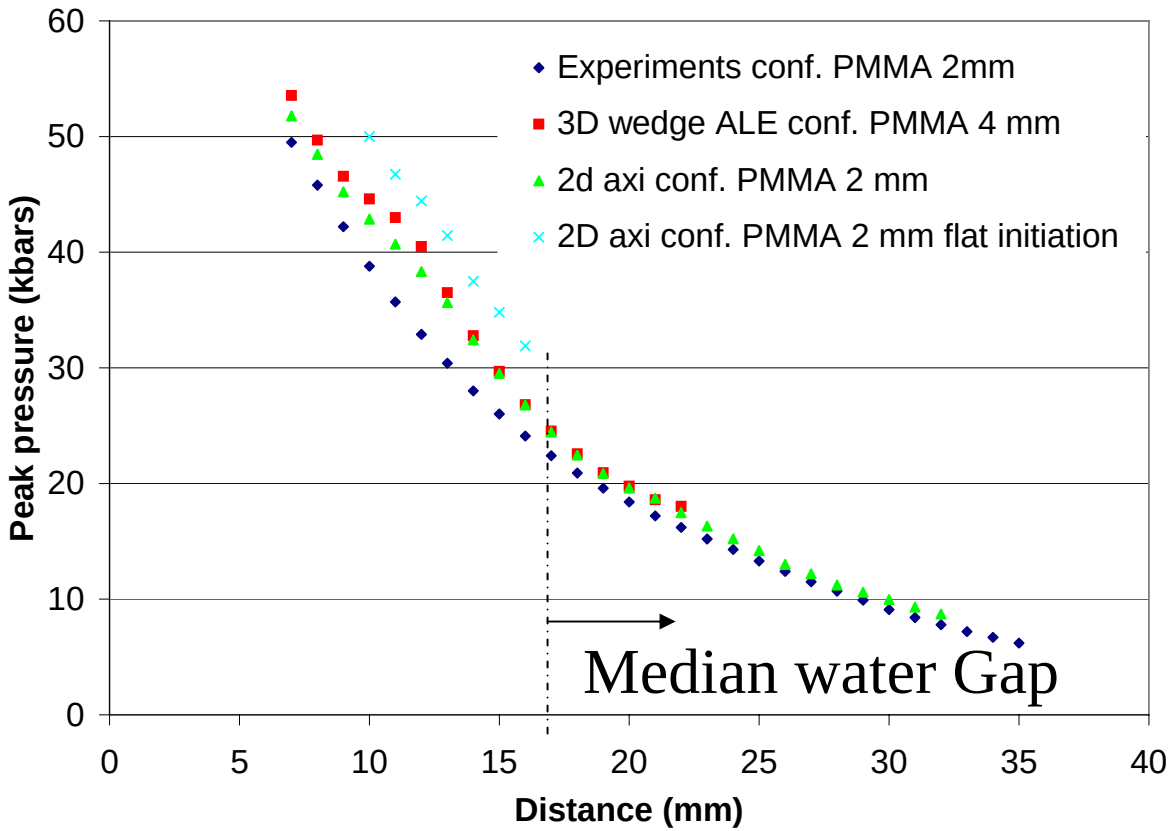
- Comparison experiments – calculations
- Effect of the PMMA confinement





Water shock wave (ECWGT)



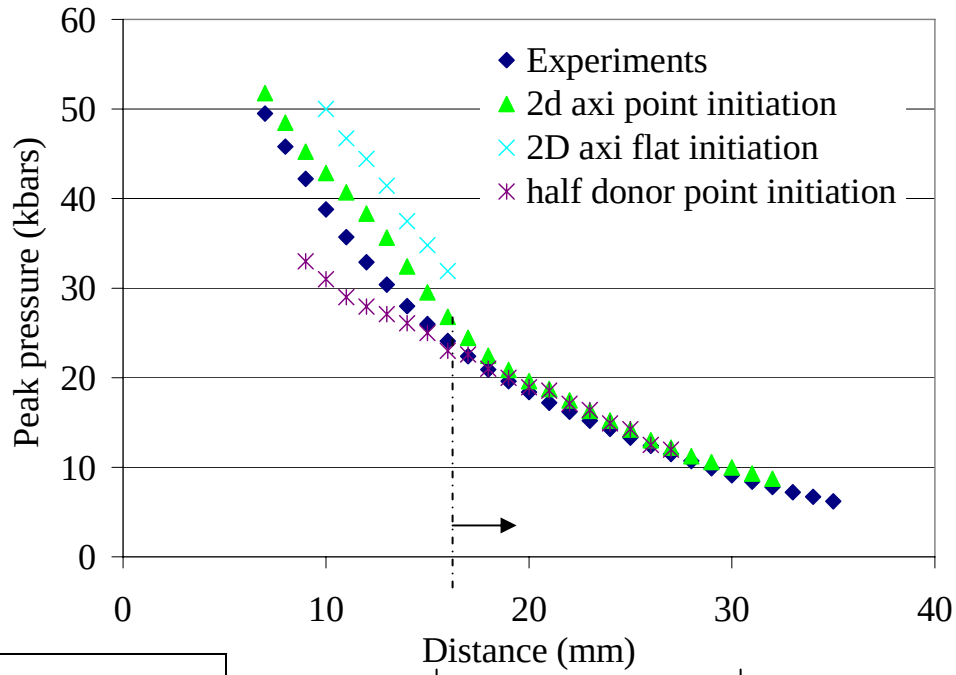


<u>Peak pressure versus distance in water :</u>

- Comparison experiments – calculations
- Effect of PMMA confinement

Go/NoGo results

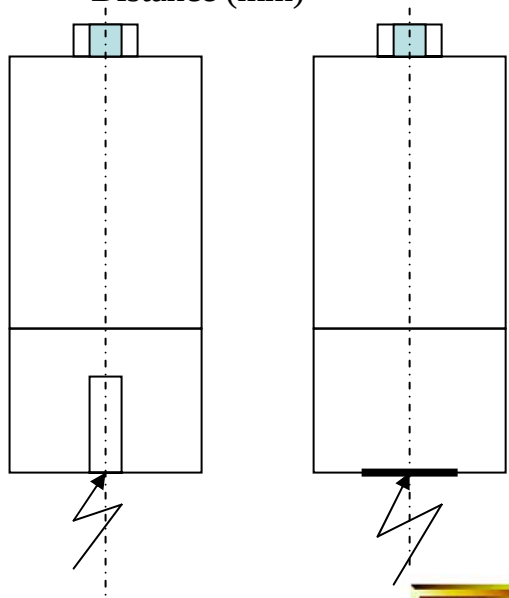
Influence of the donor pellet :
- cavity pellet
- plain pellet
- half donor



Steel confinement (target)

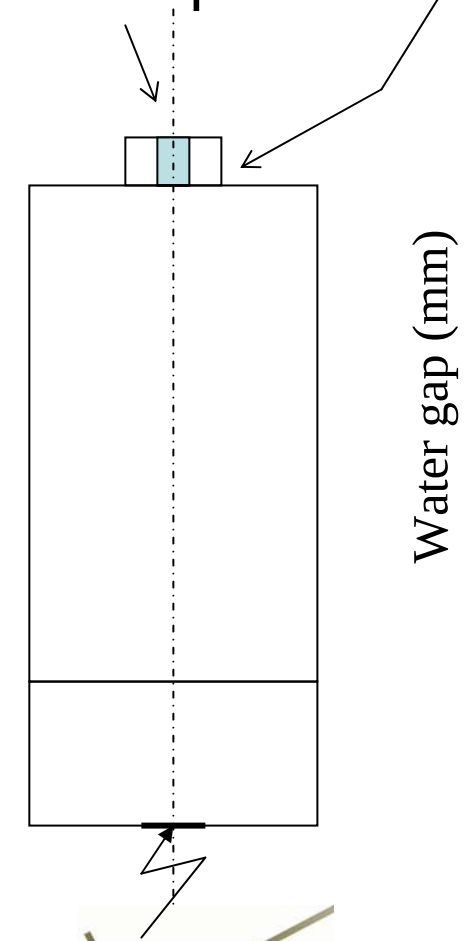
Initiation / Donor charge	Go, water gap	No Go, water gap
Point / ∅ 21 mm h 20.3 mm	-	16.7 mm
Point / ∅ 21 mm h 20.3 mm	-	20.7 mm
Flat / ∅ 21 mm h 18 mm	15 mm	17 mm
Point / ∅ 21 mm h 18 mm (simulation reference)	15 mm	17 mm

Donor charge	Go, water gap	No Go, water gap
Half height donor	26 mm	28 mm
Standard height donor	27 mm	29 mm

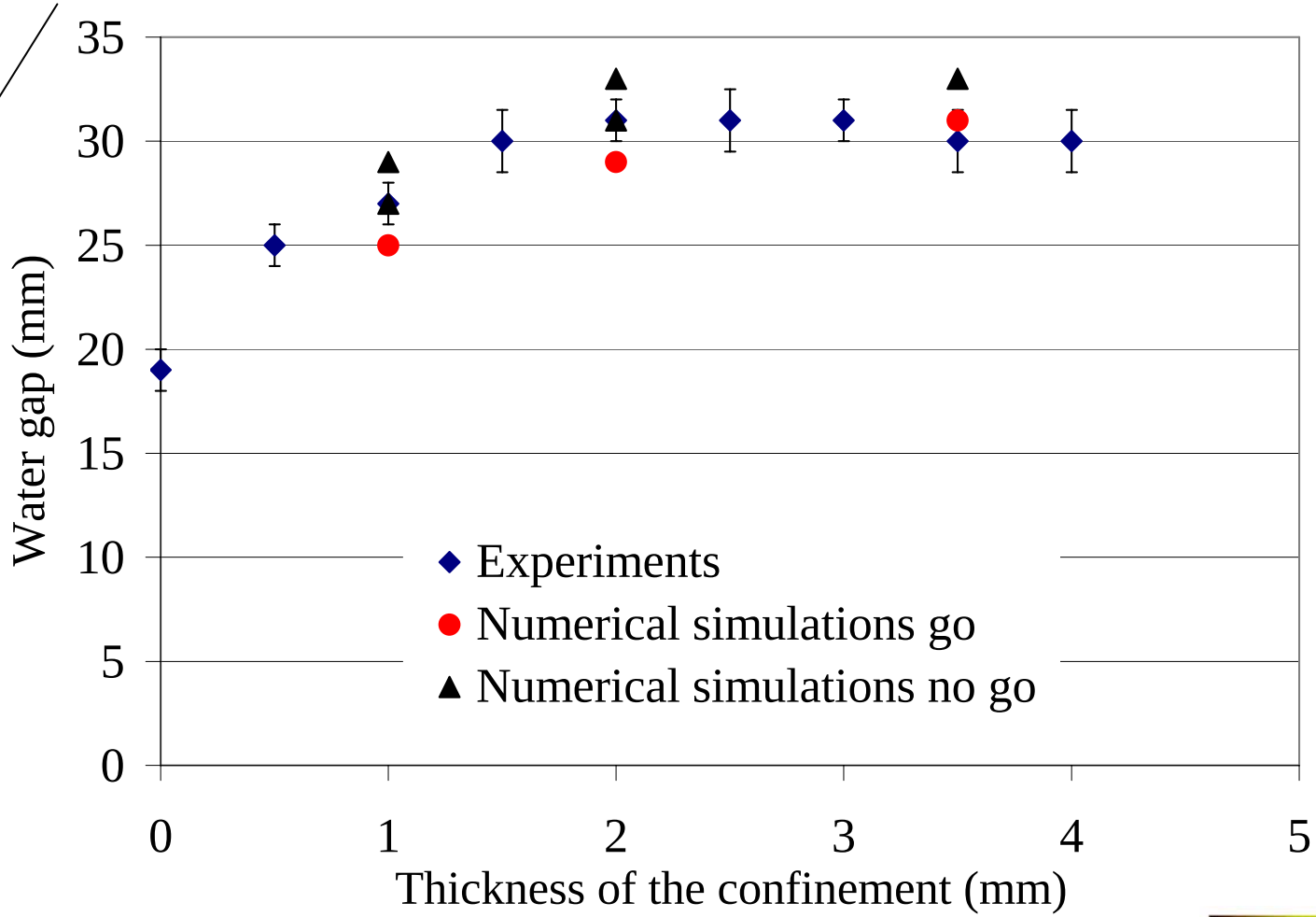


Go/No Go results

∅ 3 h 3 mm
PETN pellet

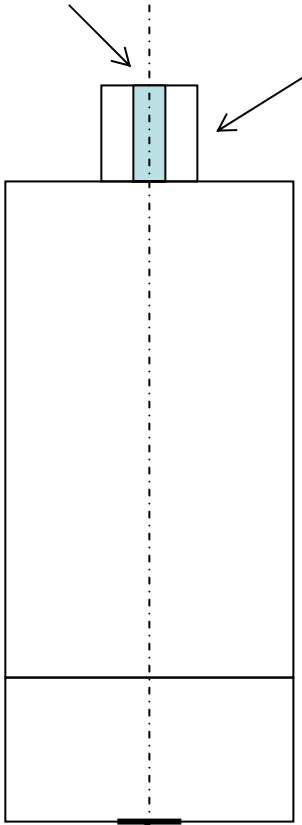


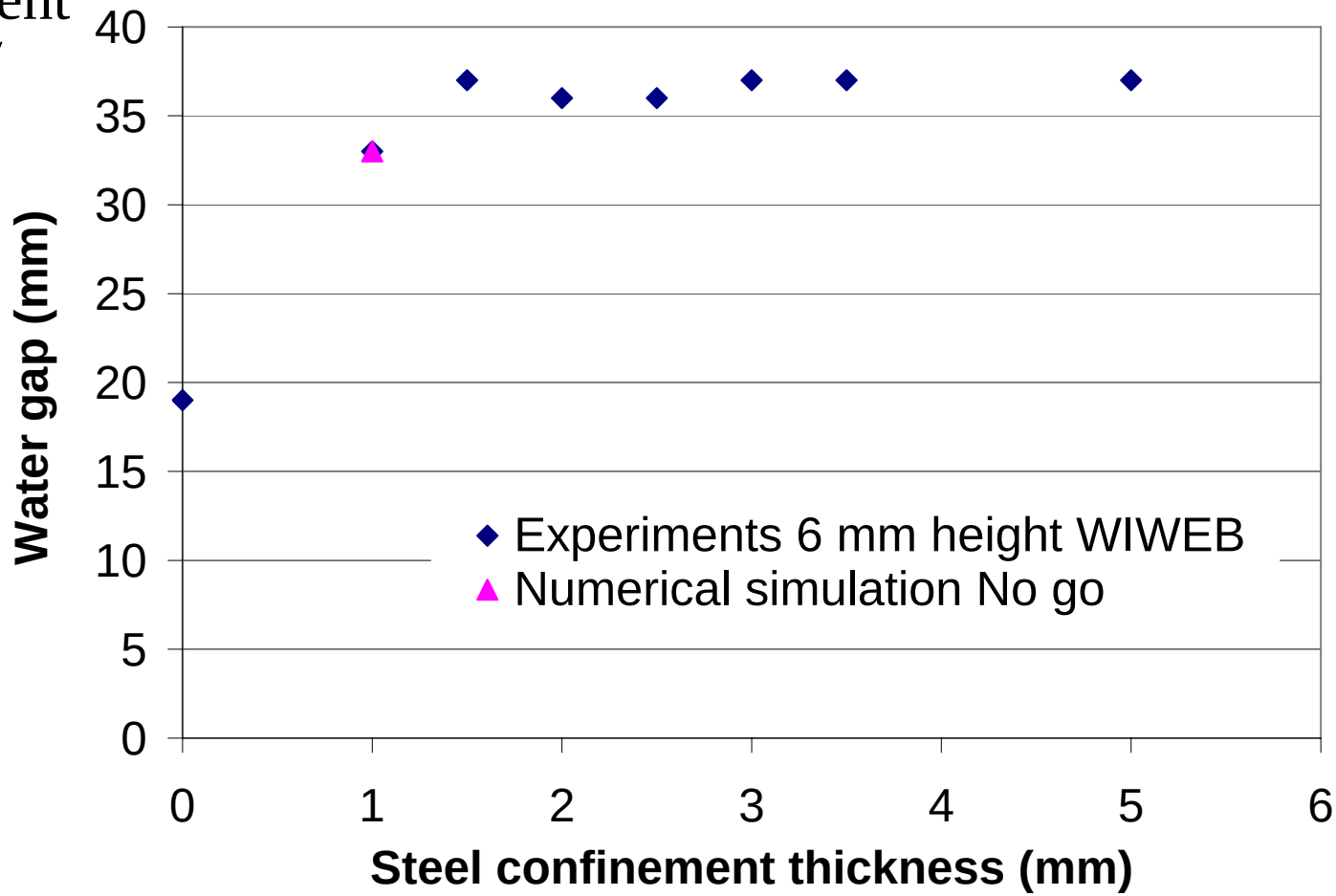
Aluminum confinement



Go/No Go results

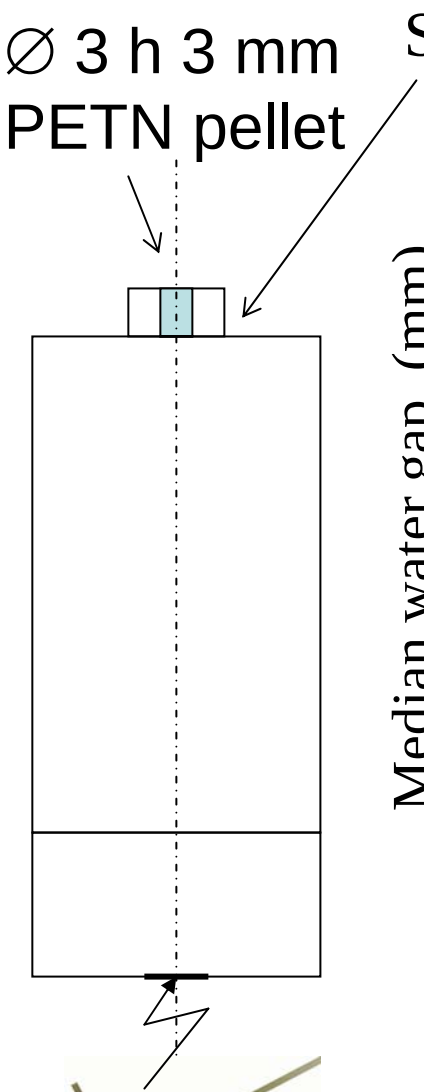
- Steel confinement
- ∅ 3 h 6 mm PETN Pellet

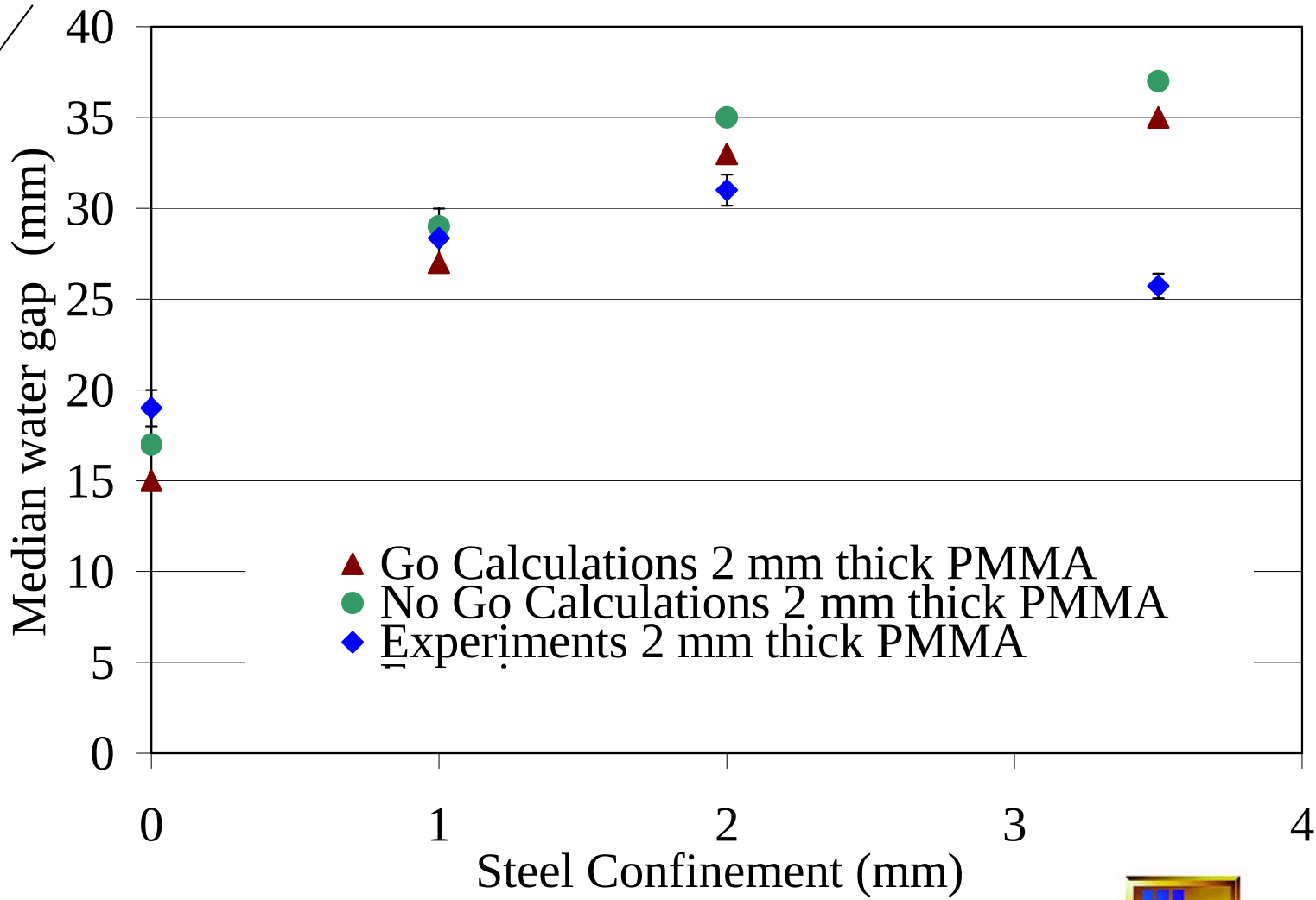




Receptor charge, ∅ 3 mm	Go, water gap	No Go, water gap
6 mm height	-	33 mm
3 mm height (reference)	27 mm	29 mm

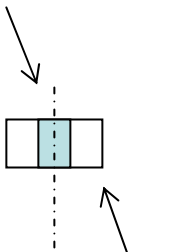
Go/No Go results



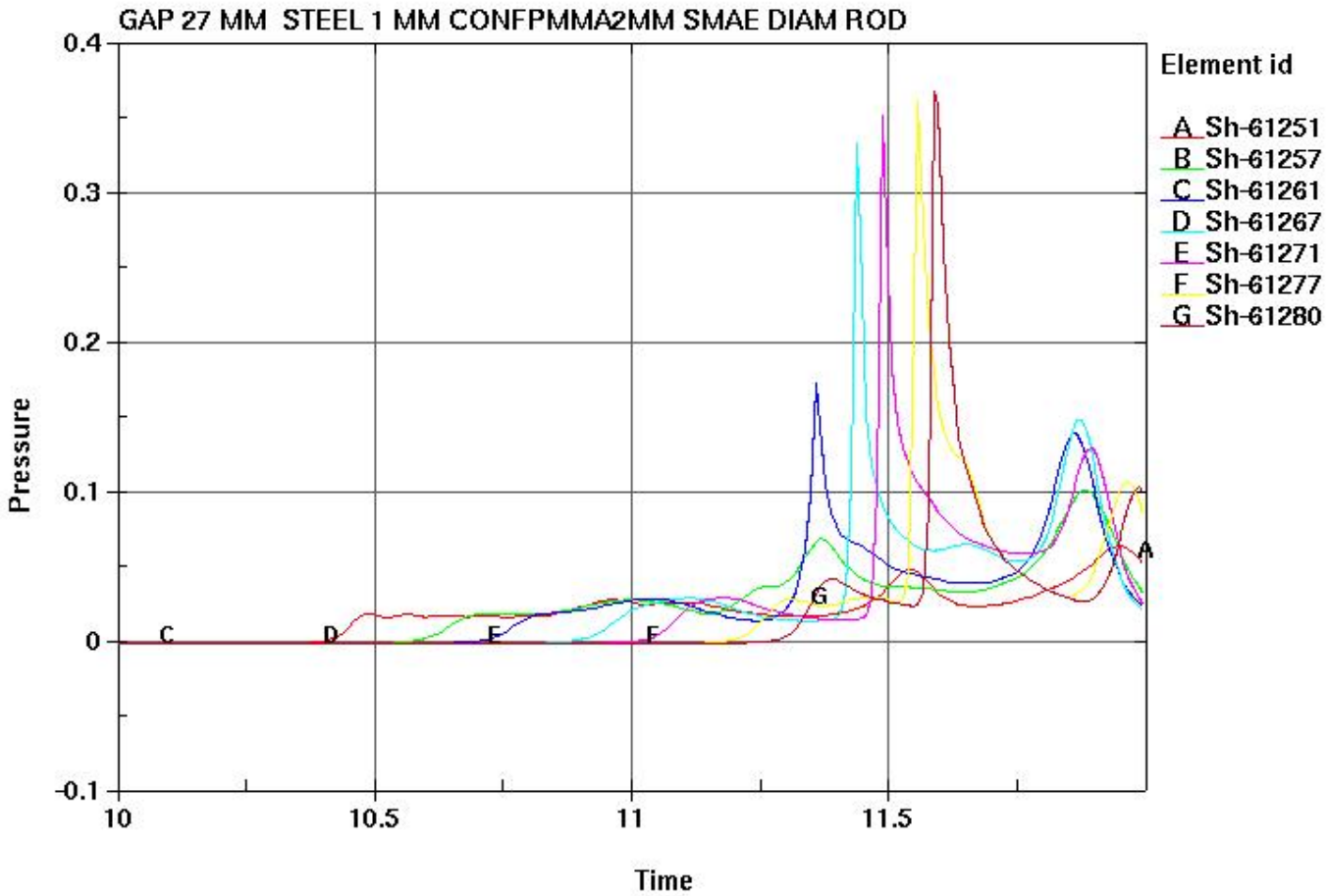


Confinement Influence on Go Results (ECWGT)

∅ 3 h 3 mm PETN pellet

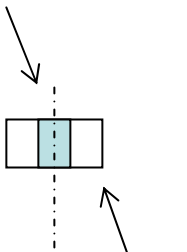


1 mm Steel confinement

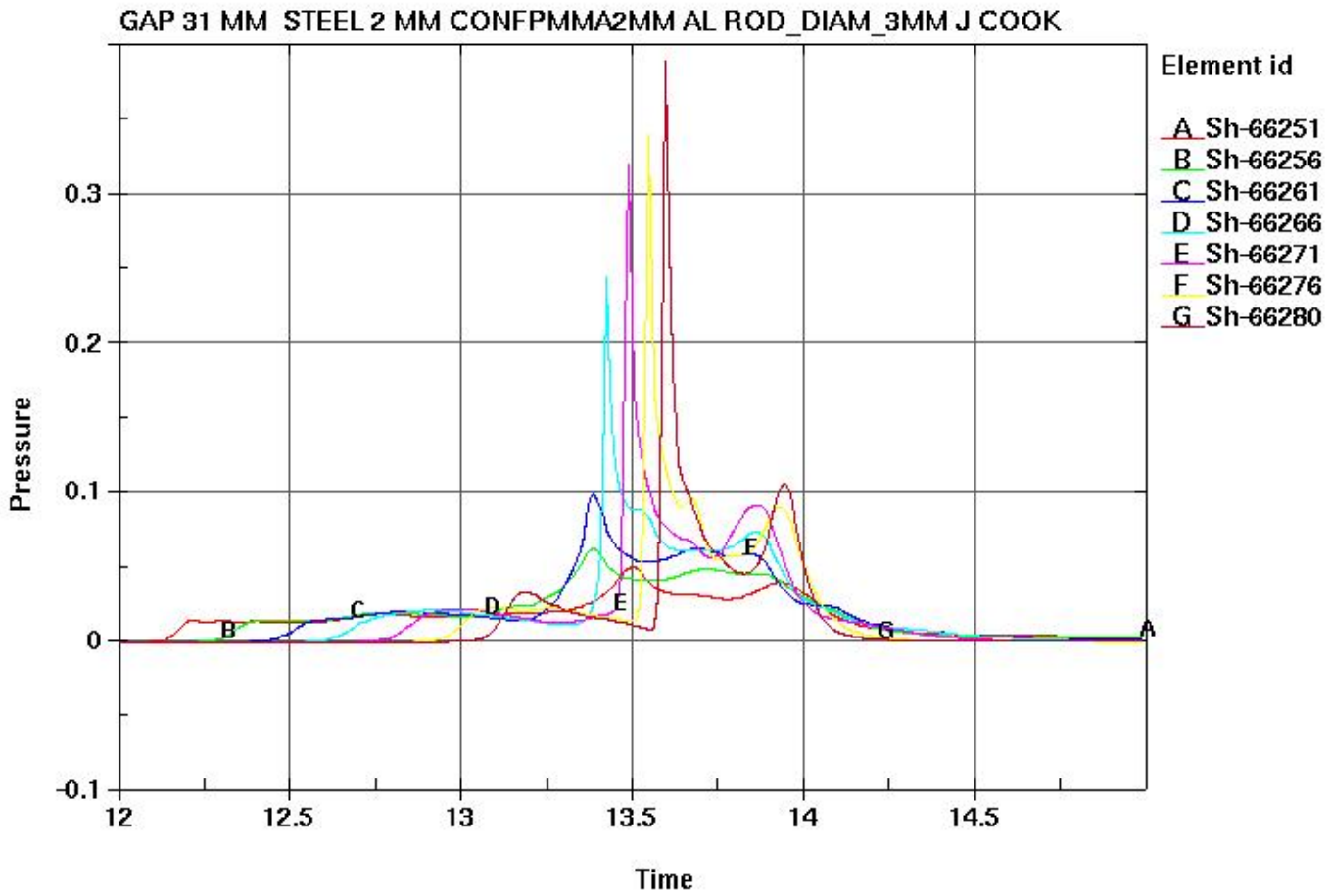


Confinement Influence on Go Results (ECWGT)

∅ 3 h 3 mm PETN pellet



2 mm Steel confinement

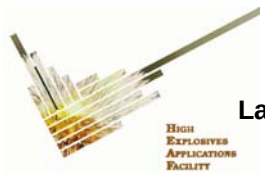


Conclusion

The numerical simulation allow us to study the following effects :

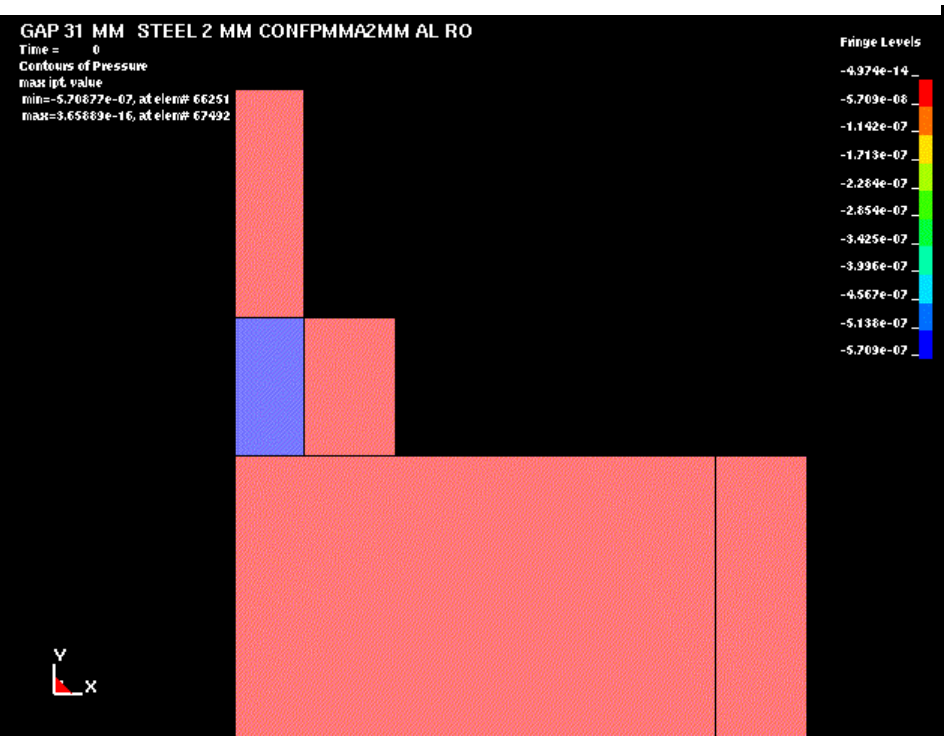
- Ignition and Growth of the PETN Pellet
- Influence of the donor charge, and point or planar initiation
- Influence of the aluminum, steel confinement thicknesses
- Influence of the height of the pellet
- Influence of PMMA confinement (water column)
- Influence of constitutive laws on go/no go threshold
- Influence of glue between Pellet and witness rod

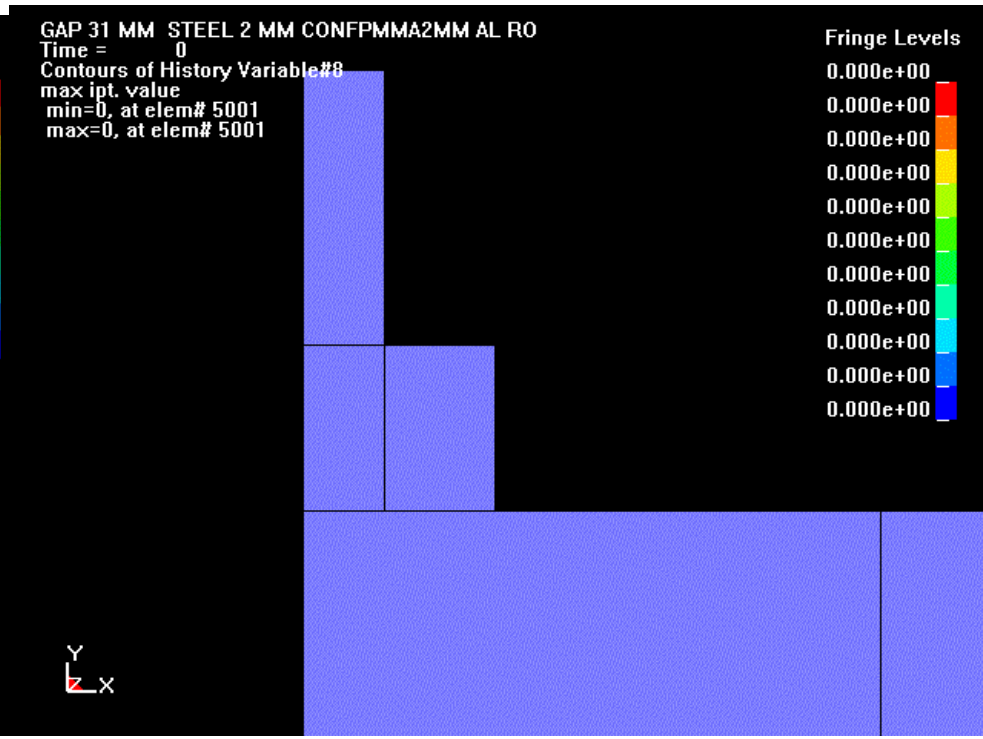
Experimental results are related for 2 mm and 3.5 mm confinement with desensitization due to the second lateral re-shock from the steel confinement



Confinement Influence on Go Results (ECWGT)

Gap 31 mm steel 2 mm pressure – Burn fraction





Confinement Influence on Go Results (ECWGT)

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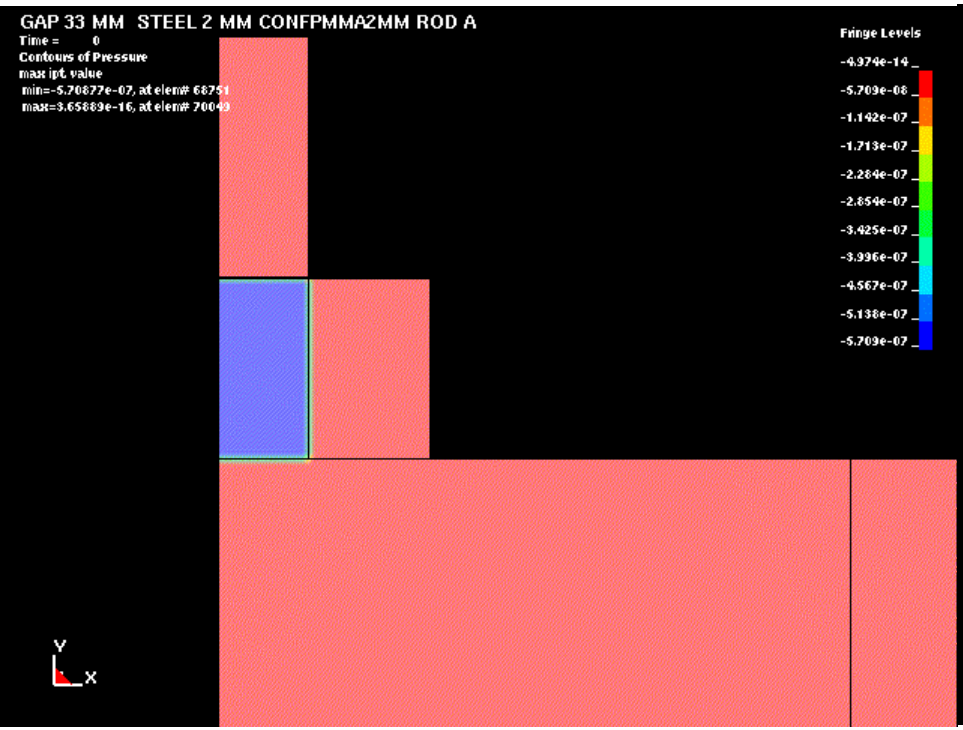
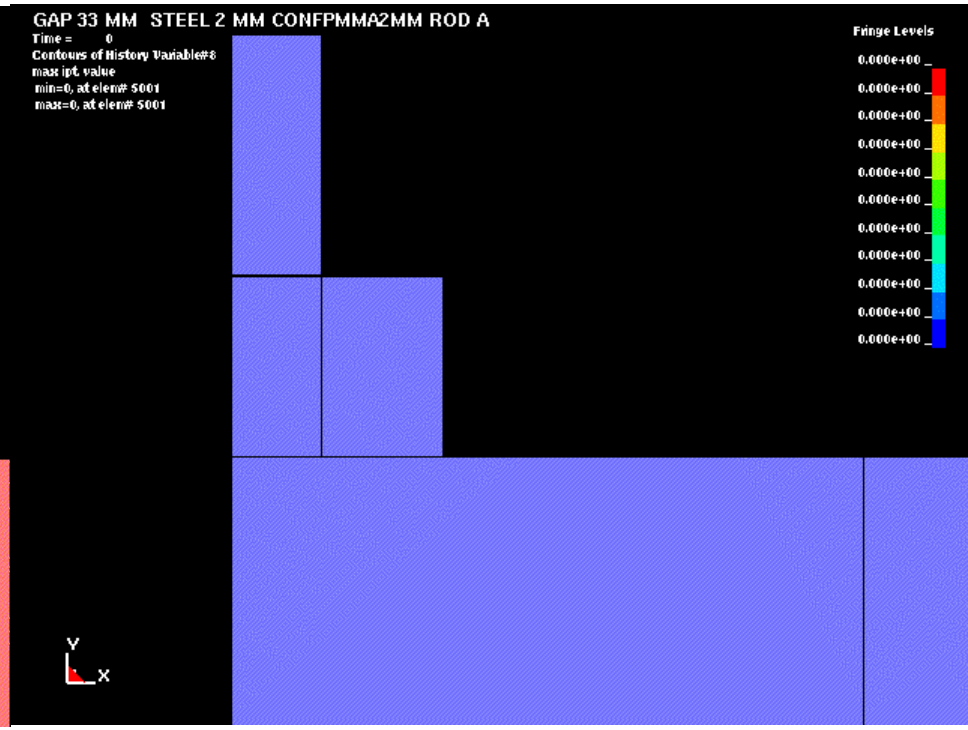
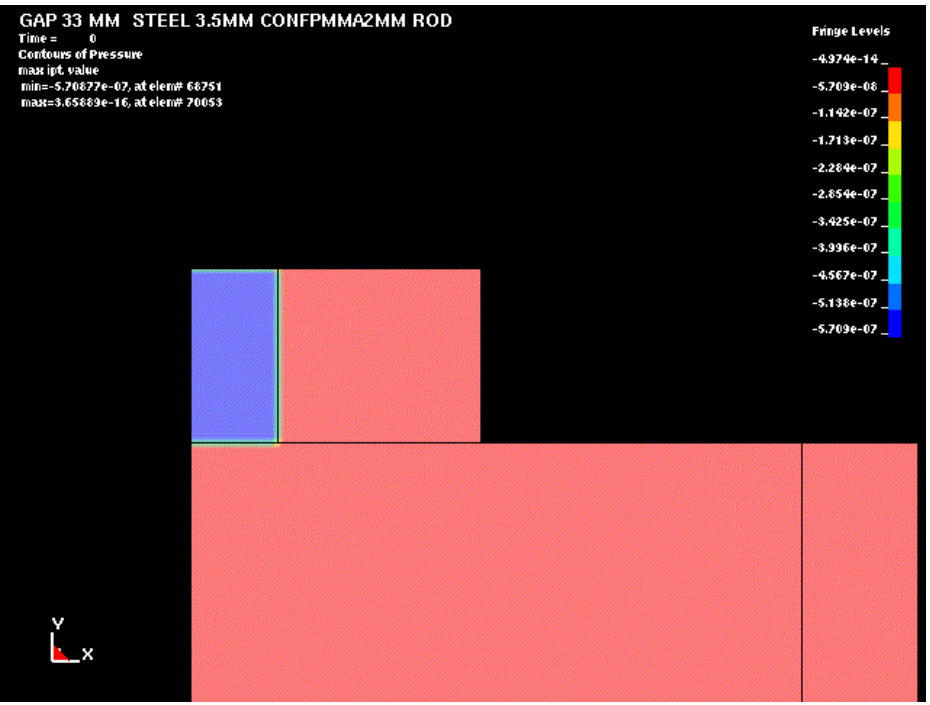
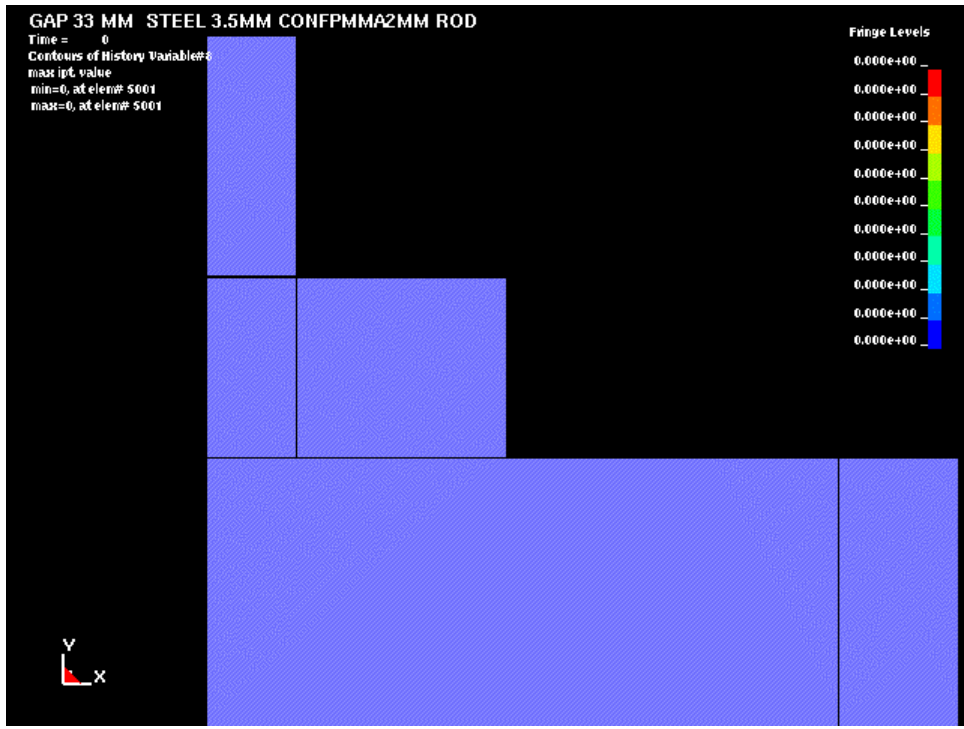




Confinement Influence on Go Results (ECWGT)

Gap 33 mm steel 3.5 mm pressure – Burn fraction





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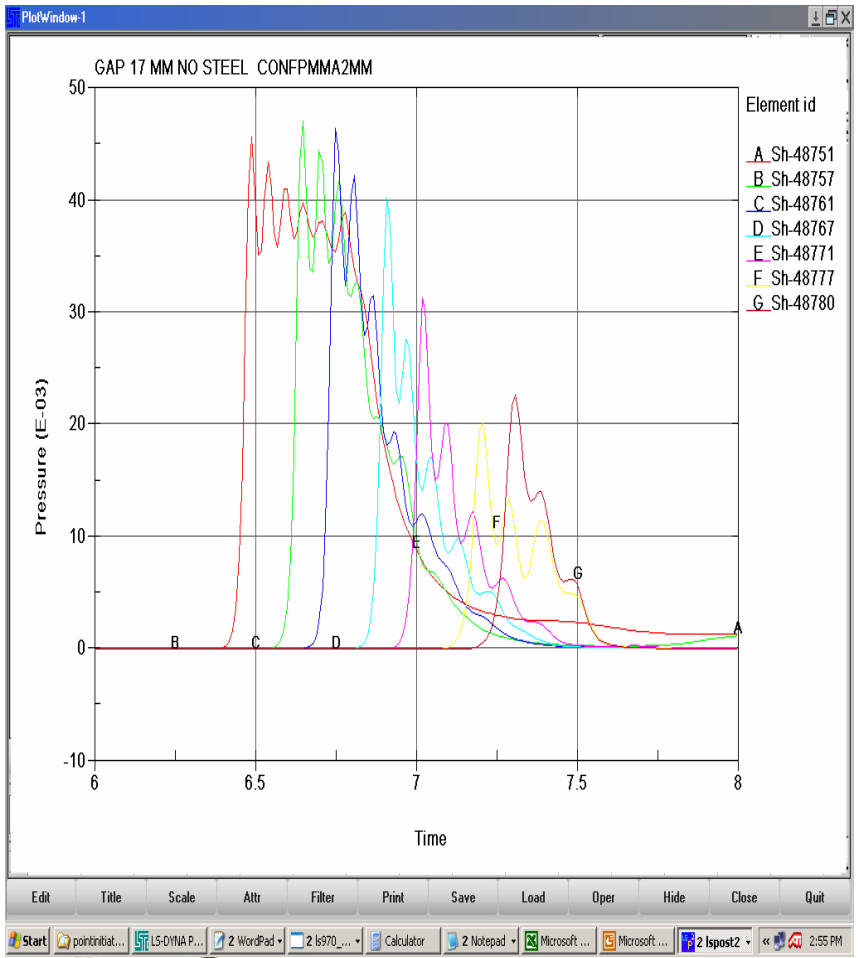

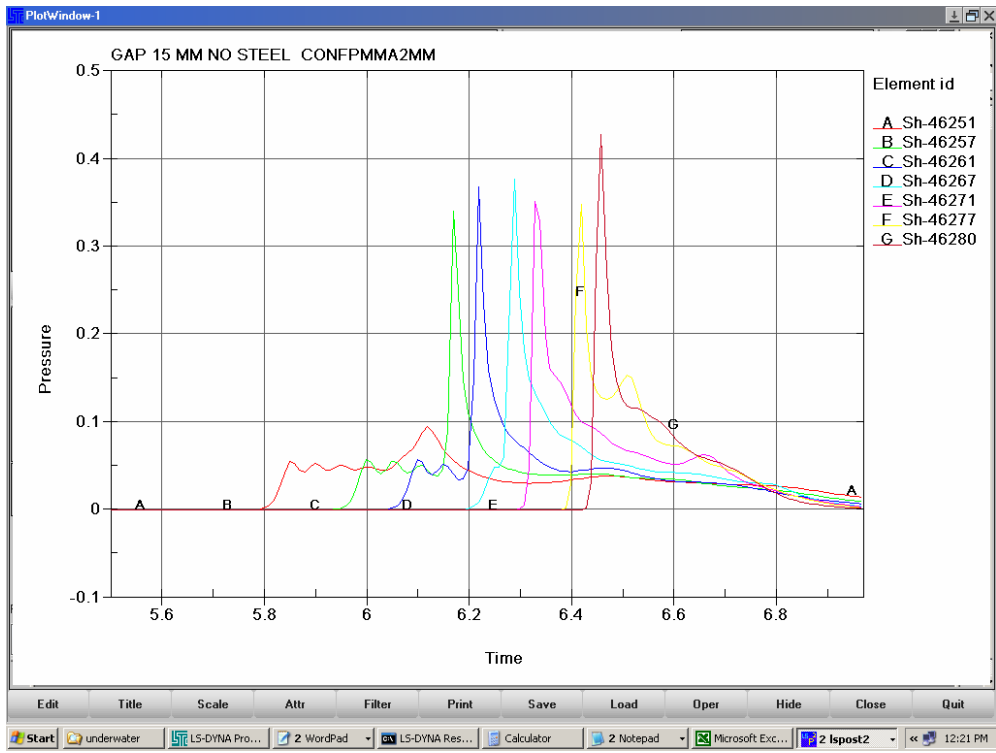

Flat initiation