

Finite Element Modeling of Primer Impact to Understand the Dynamics of Misfires

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Reliable and Consistent Performance

- No Misfires
- No Inadvertent Firing
- No Leaky Primers
- No Pierced Primers
- No Dropped Primers

Quantify the effects of Geometry and Material Strength on Primer Sensitivity

- **Geometry—Base Thickness—Thin or Thick**
- **Material Strength—Cup Hardness—Soft or Hard**
- **Combination determine Primer Strength**
- **Both controllable in manufacturing**
- **FEA eliminates other variables for focus**
- **FEA can differentiate results with finer resolution than bang or no bang**

Axisymmetric Finite Element Analysis using ABAQUS Explicit

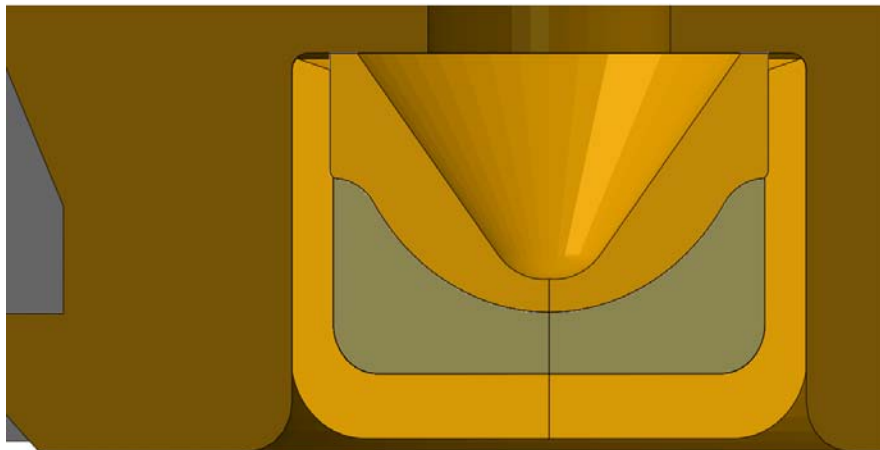
Two Primer Cup Geometries—Thin and Thick = $4/3$ Thin

Two Primer Cup Materials—Soft and Hard

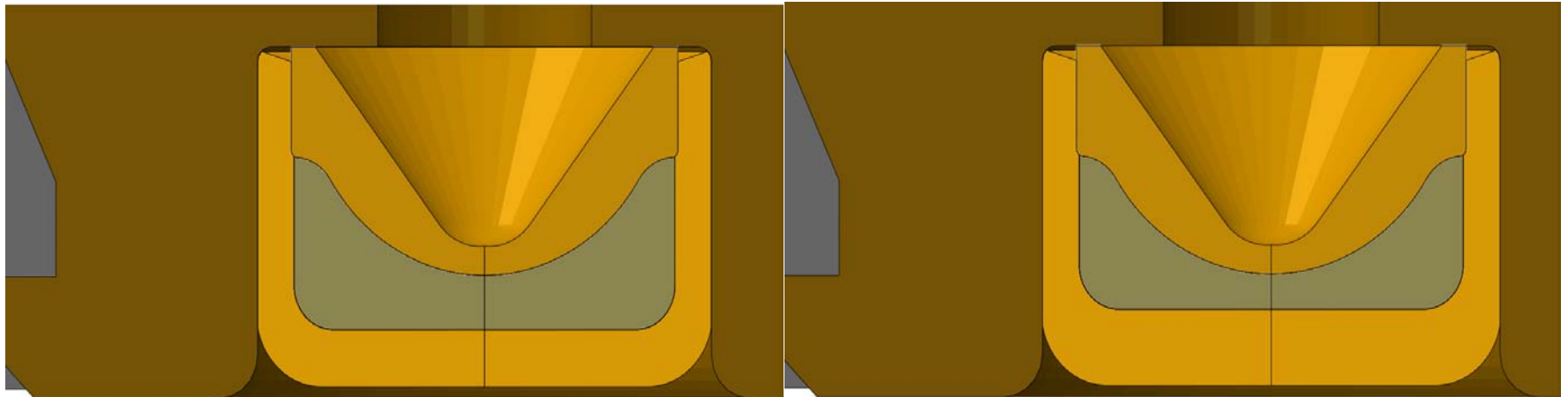
Mix material model designed to approximate events leading to detonation

All else the same

Thin



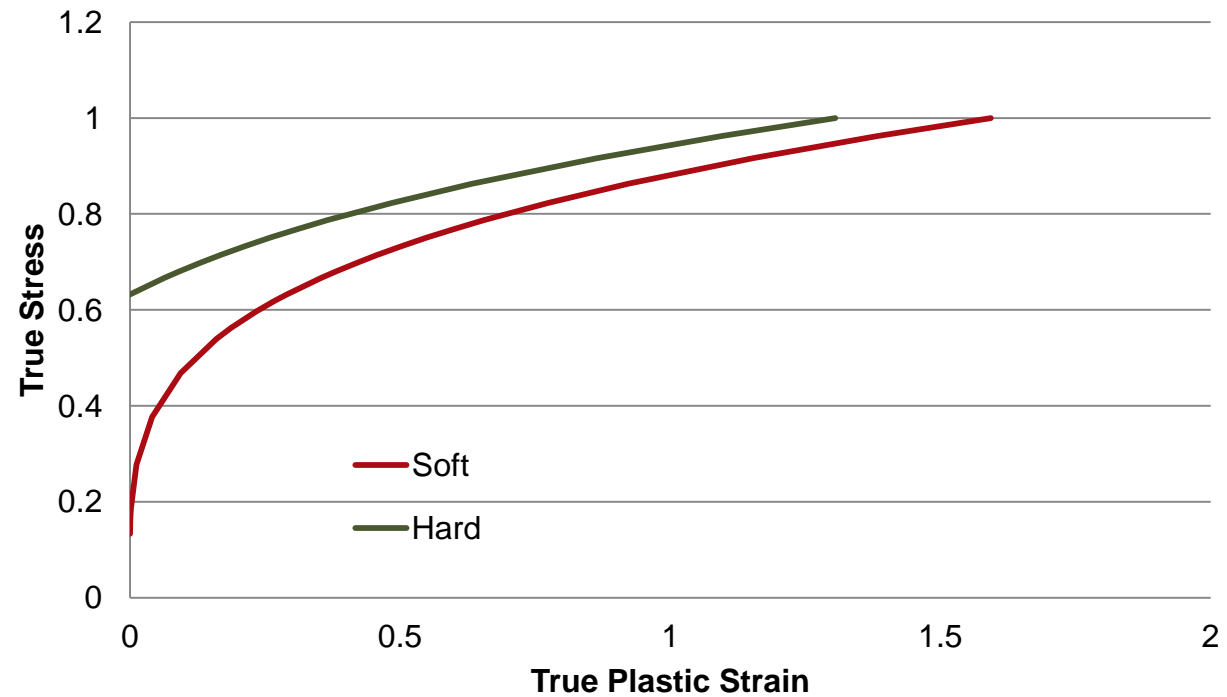
Thick



Soft Implies Low Elastic Limit

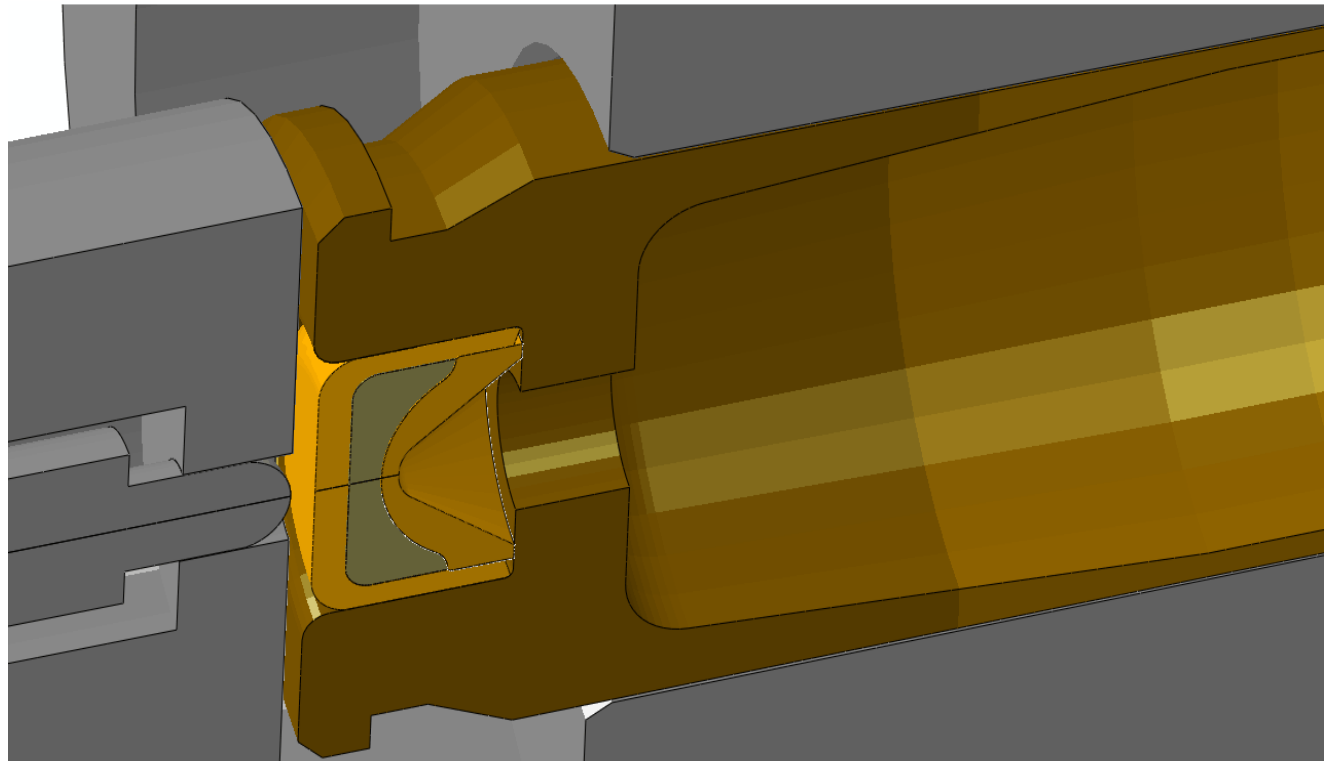
Hard Implies High Elastic Limit

True Plastic Strain



Identical for every simulation—not possible in physical testing

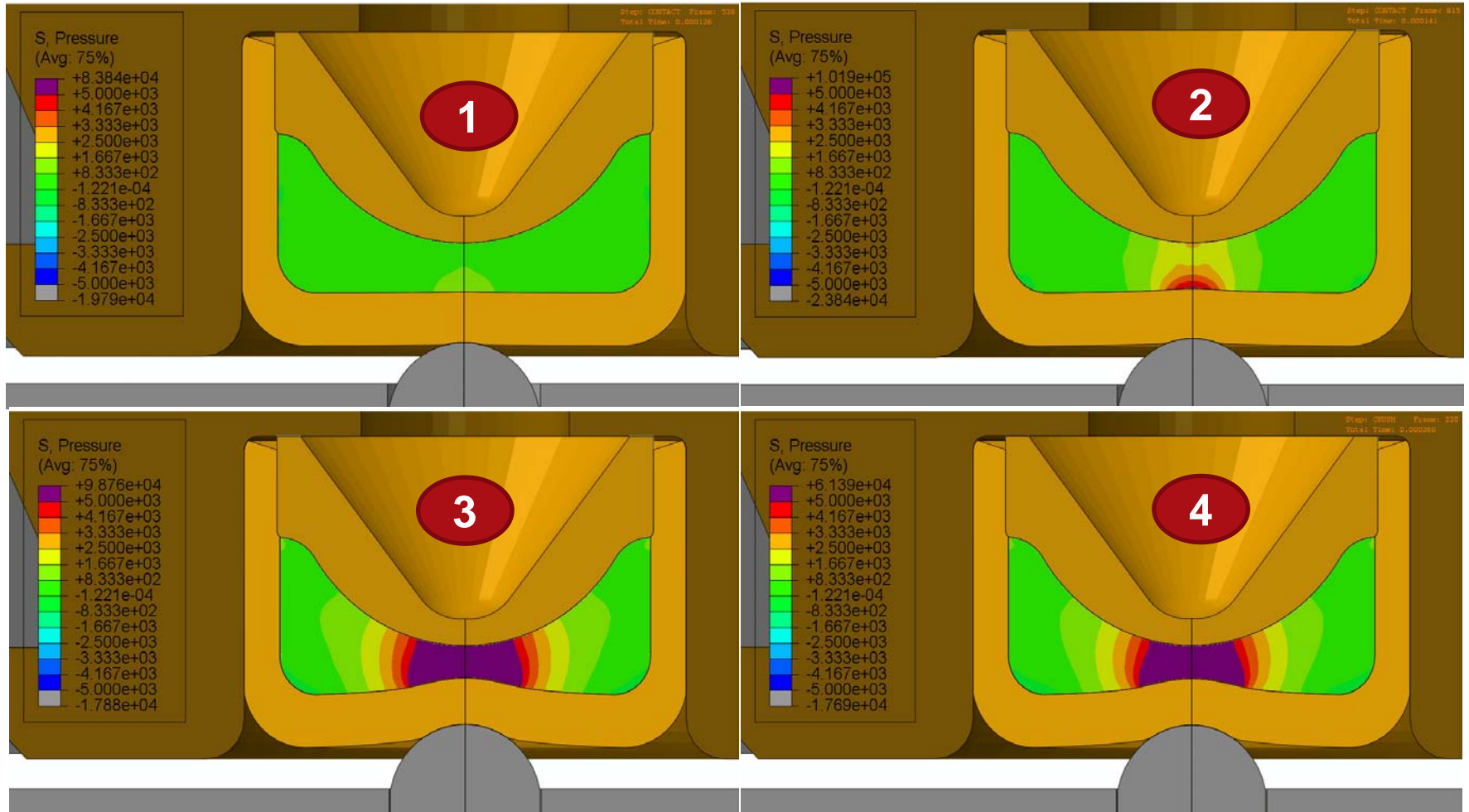
- Energy input to firing pin—low for a weapon
- Firing Pin
- Bolt Face
- Primer Anvil
- Primer Depth
- Case
- Chamber



Primer Impact Sequence Shows Pressure Development

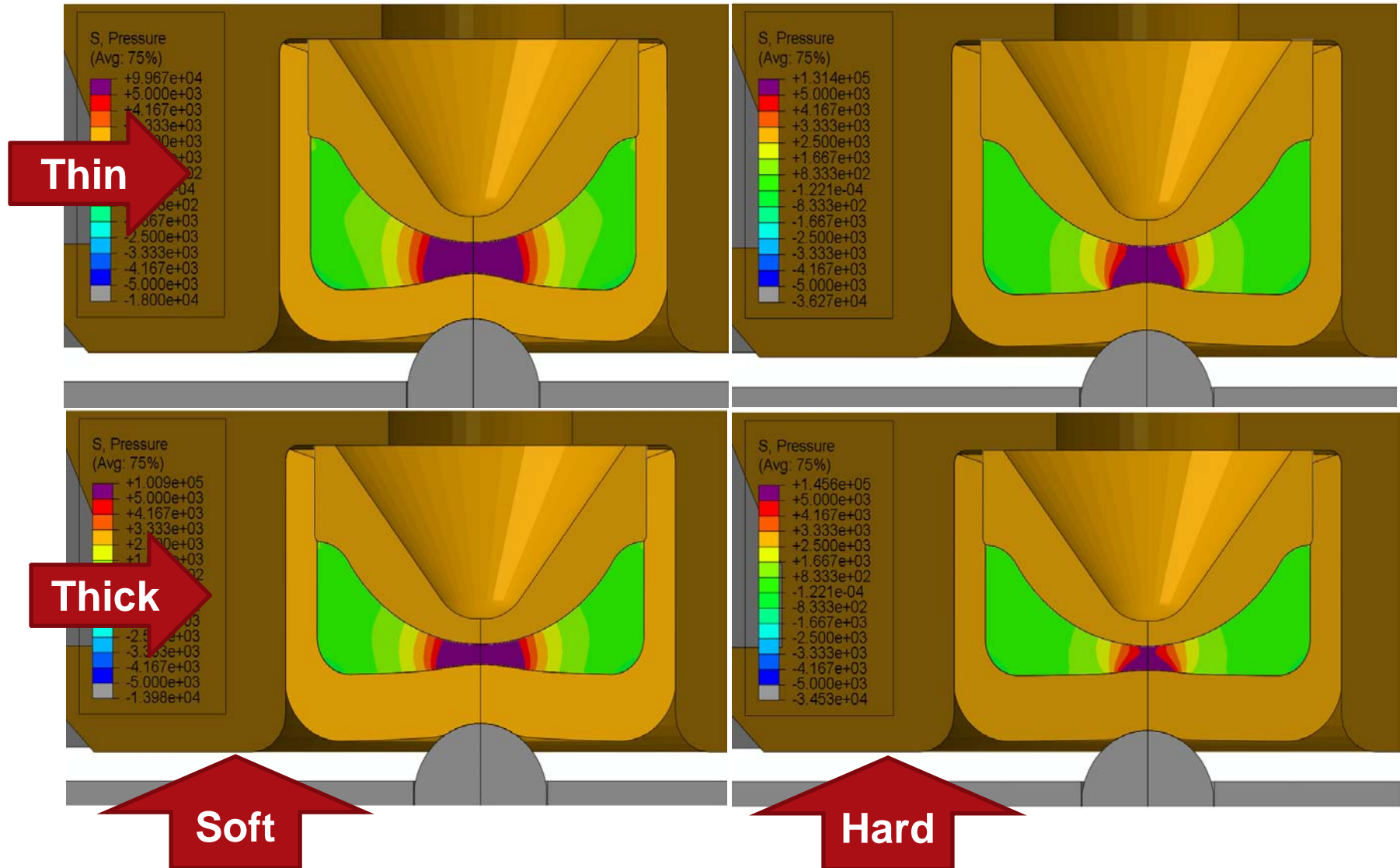


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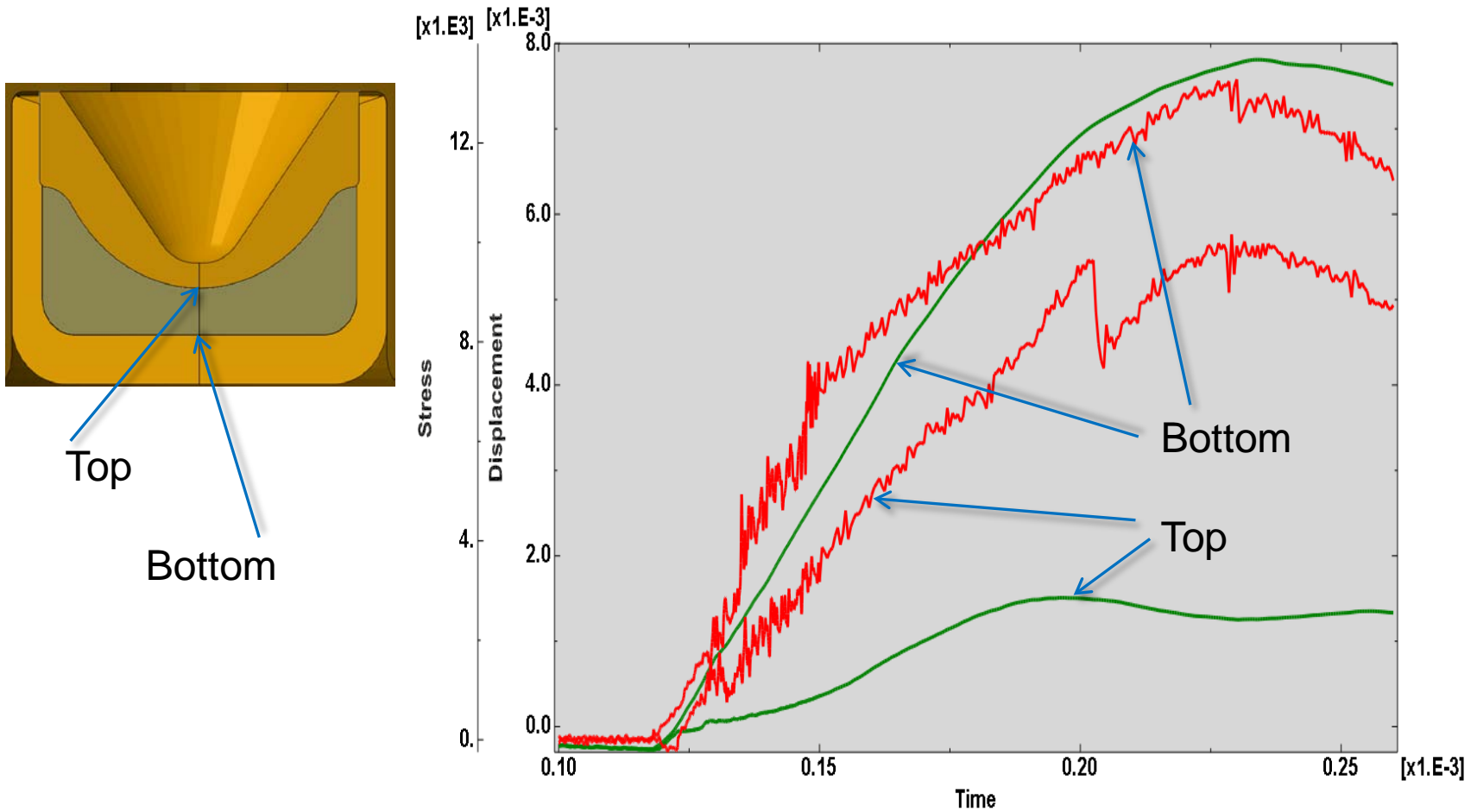
Extent of "threshold" pressure

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The green curves show displacement at the top and bottom center of the mix

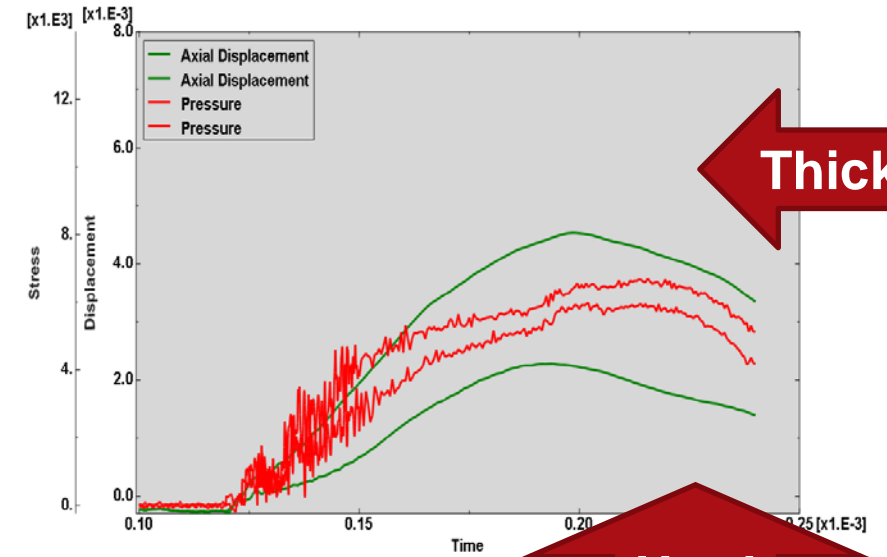
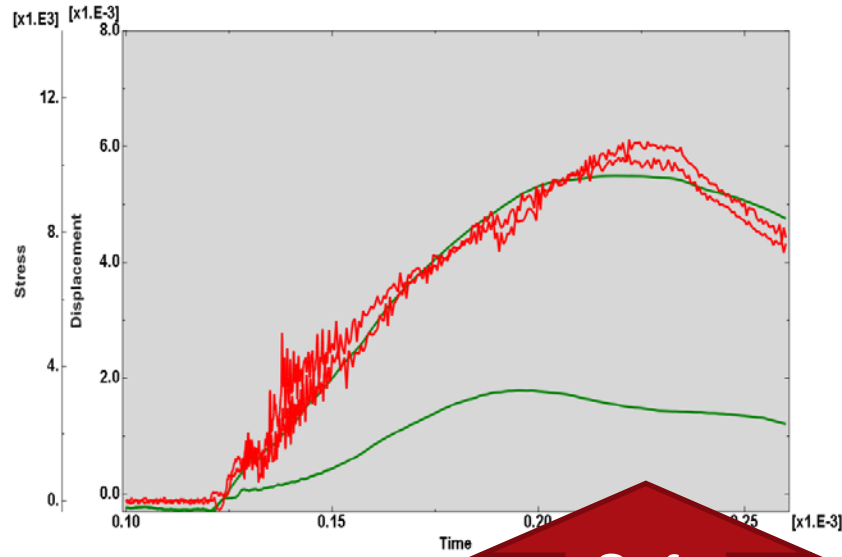
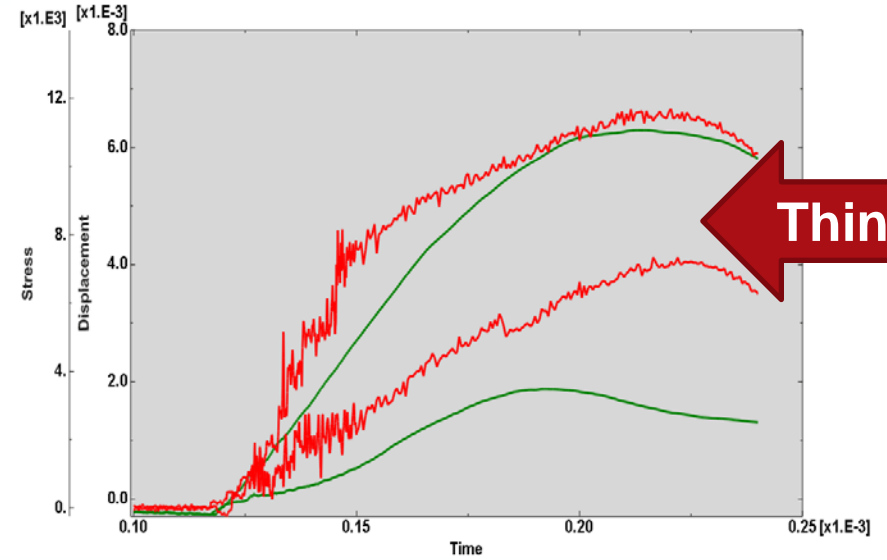
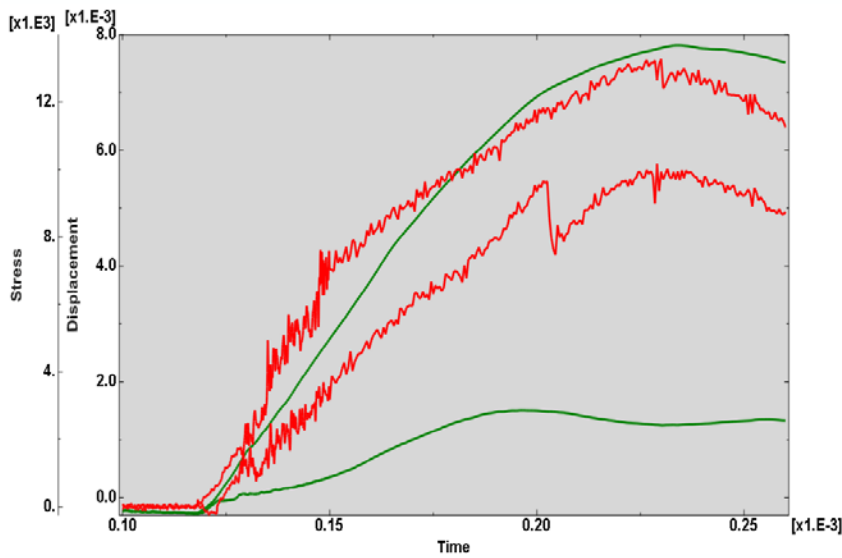
The red curves show pressure



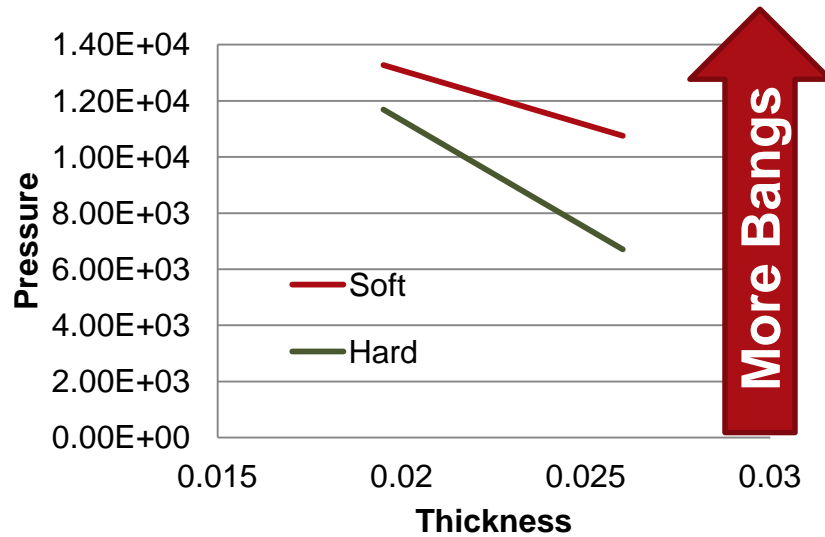
Pressure and Displacement History



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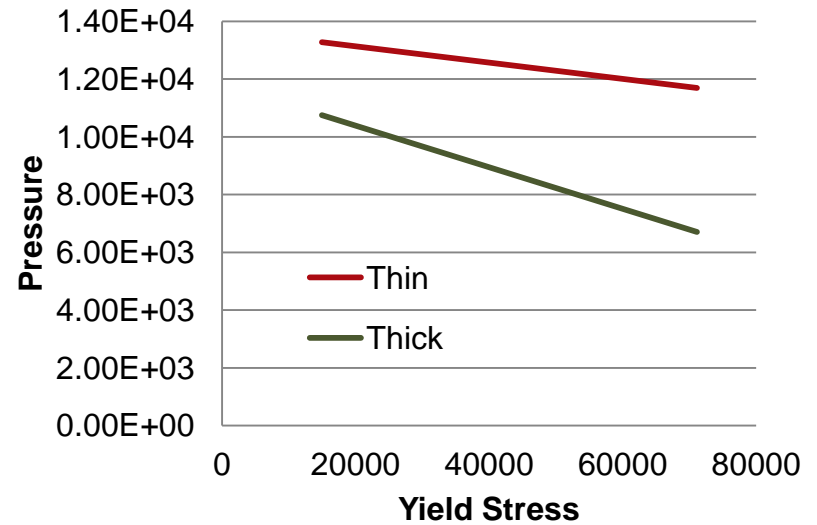


Thickness Effect



Thinner

Hardness Effect



Softer