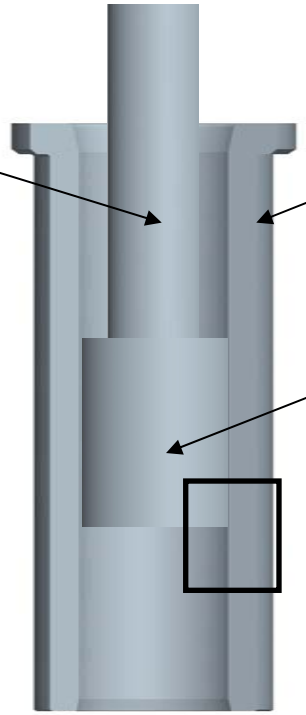
RDECOM

TECHNOLOGY DRIVEN. WARFIGHTER FOCUSED.

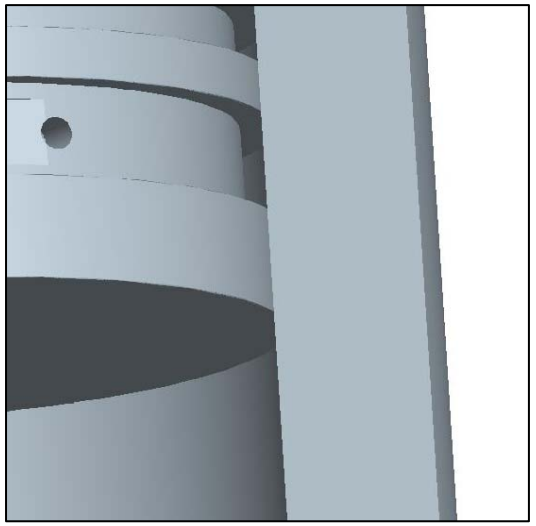
Polyurethane Press Tooling Components

October 15-18, 2007

Background

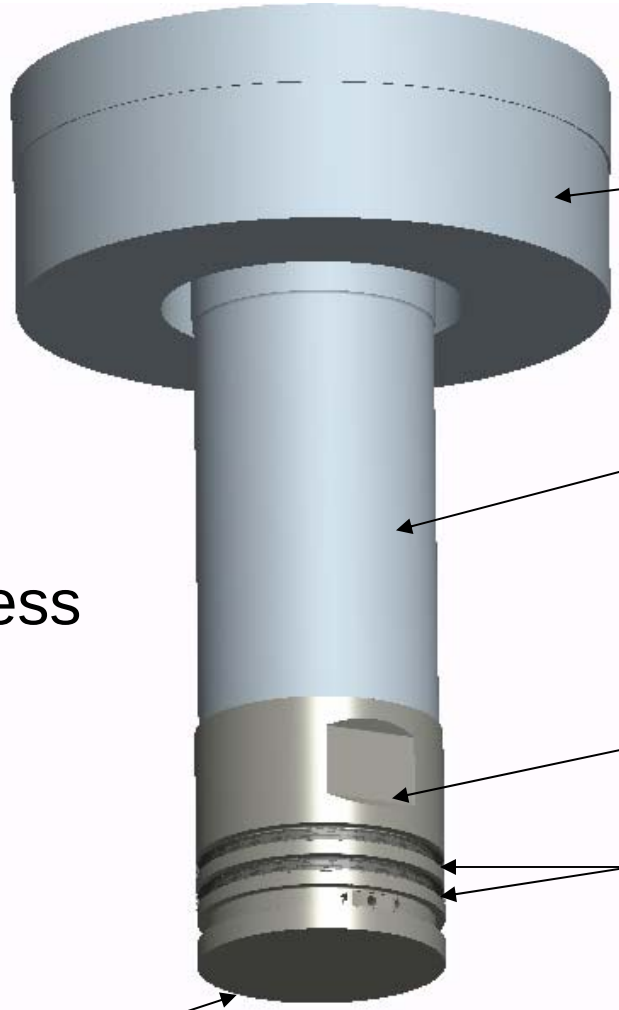


- Inadvertent tooling damage
- Dynamic conditions
- Tool impingement
- Tight tool clearances
- ARDEC is developing a solution using high-solids polyurethane.

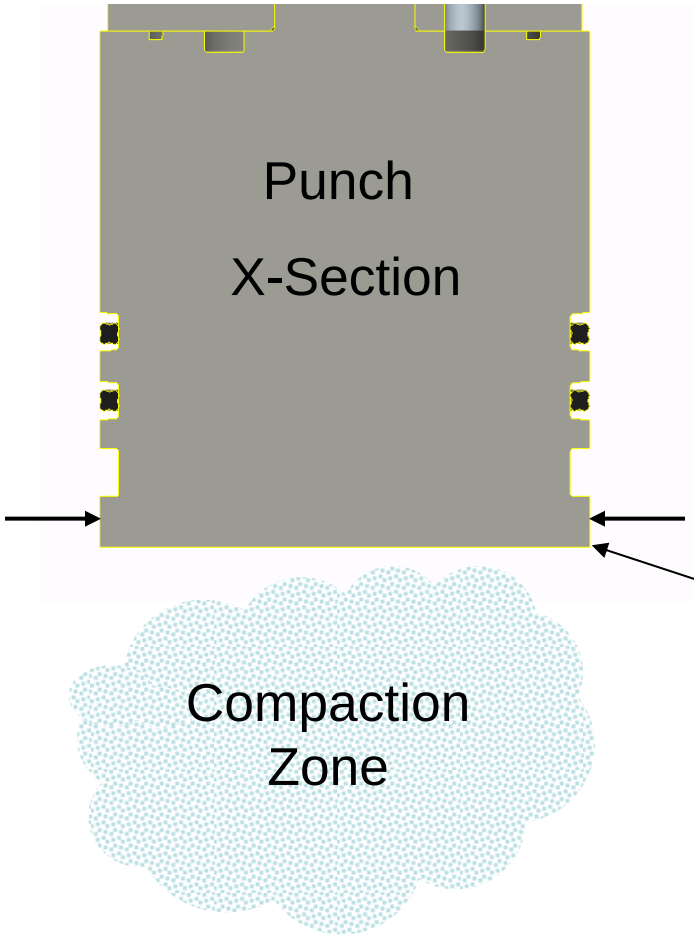


Background – Cont.

- A-2 Tool Steel
- 56-58 RC Hardness
- 8 Micro-finish



Background – Cont.

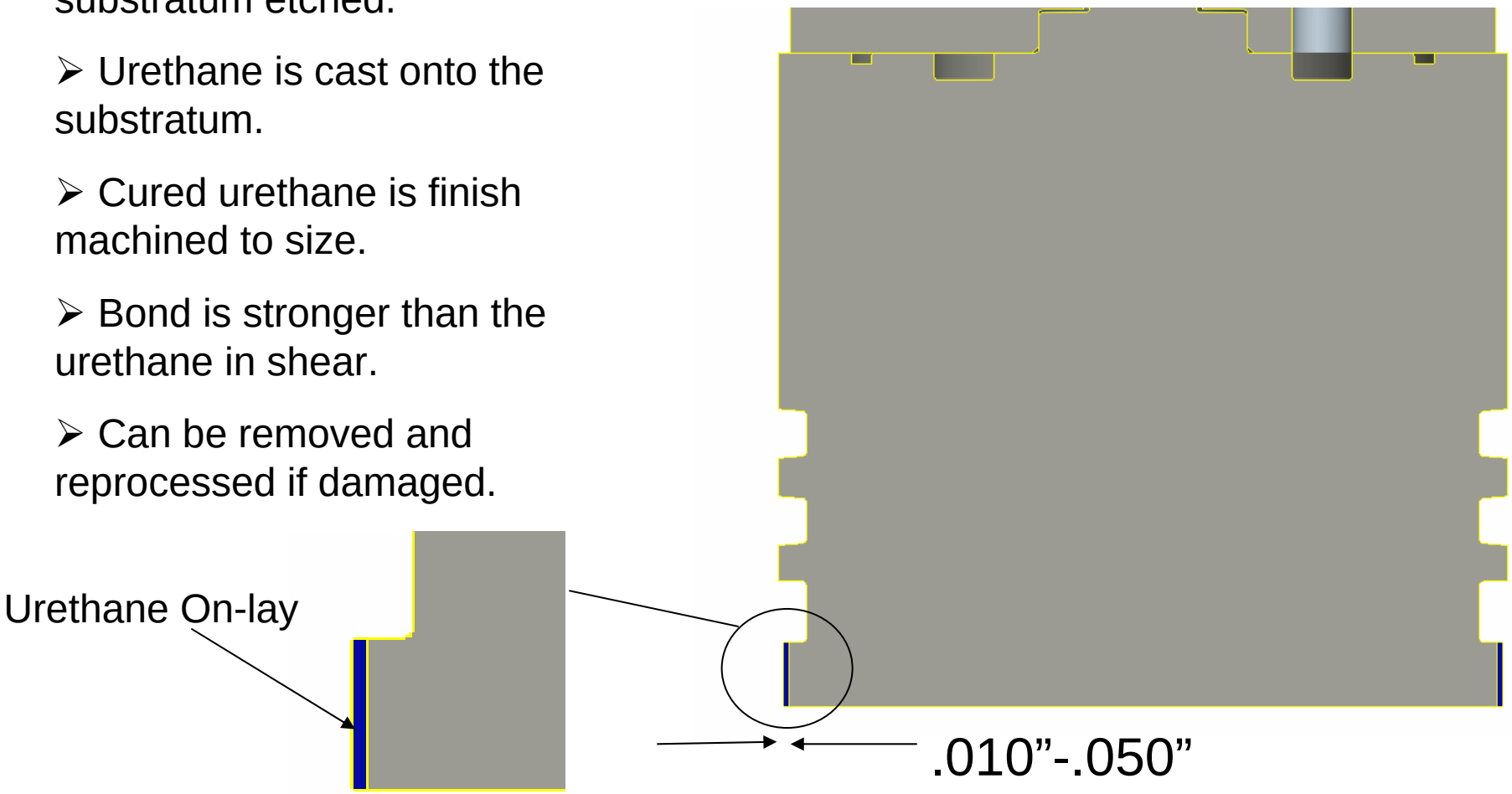


Problem: Tooling damage caused by sharp leading edge ***and*** close punch-wall clearance.

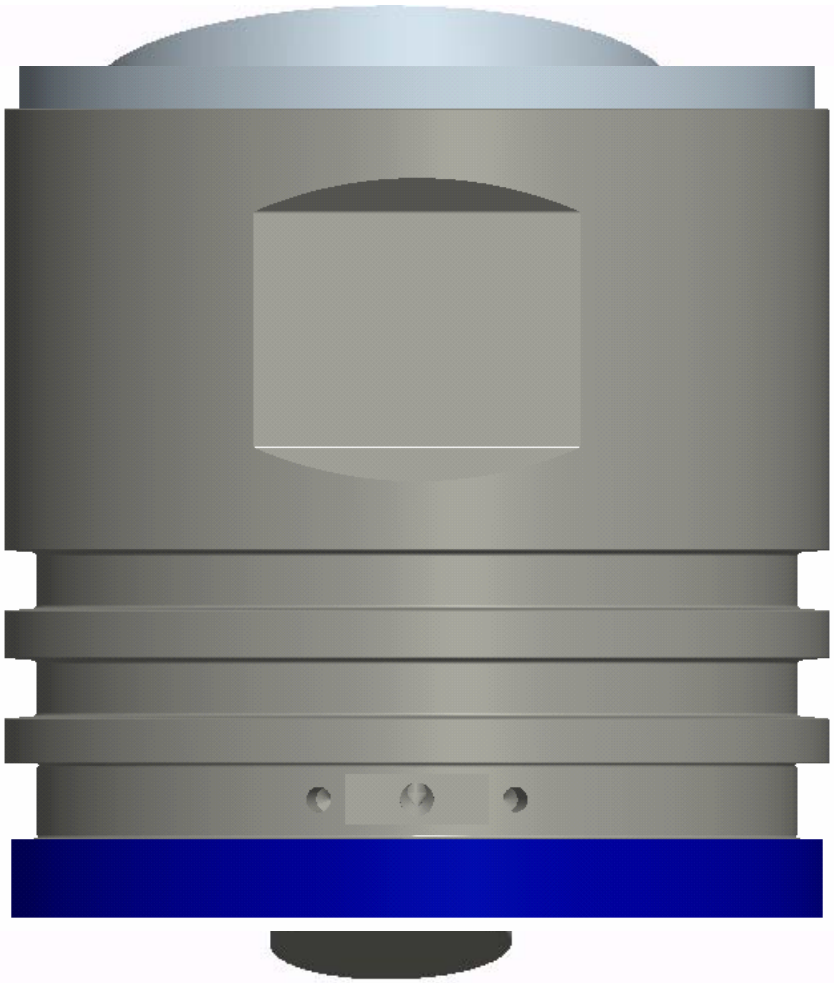
Solution: Replace the sharp leading edge with high durometer polyurethane.

Background – Cont.

- Tool is machined and substratum etched.
- Urethane is cast onto the substratum.
- Cured urethane is finish machined to size.
- Bond is stronger than the urethane in shear.
- Can be removed and reprocessed if damaged.

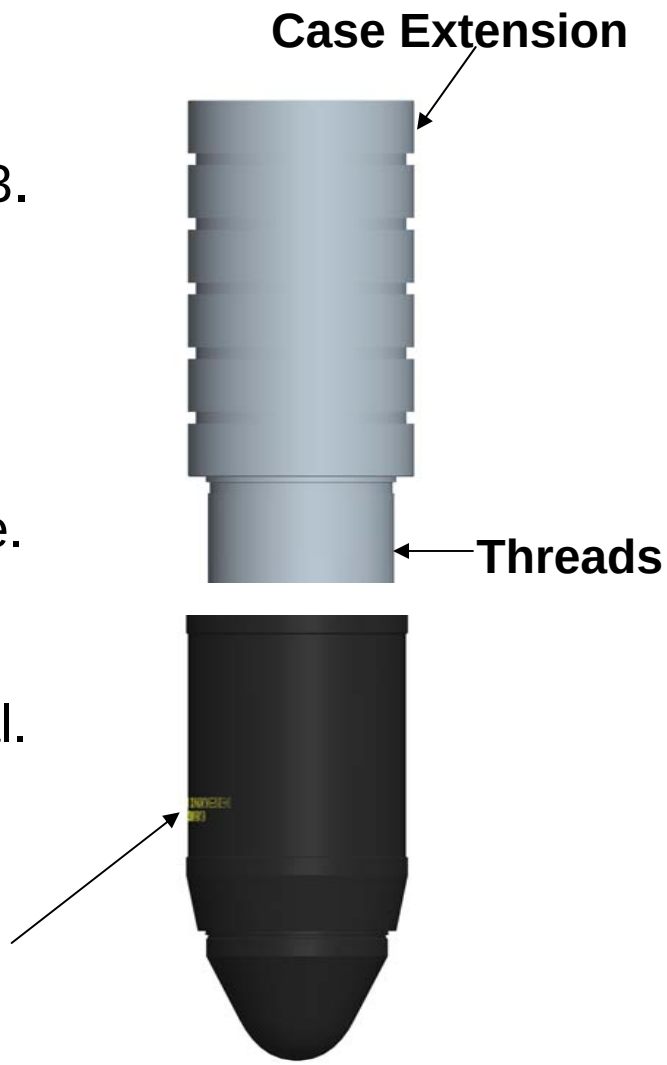


Background – Cont.



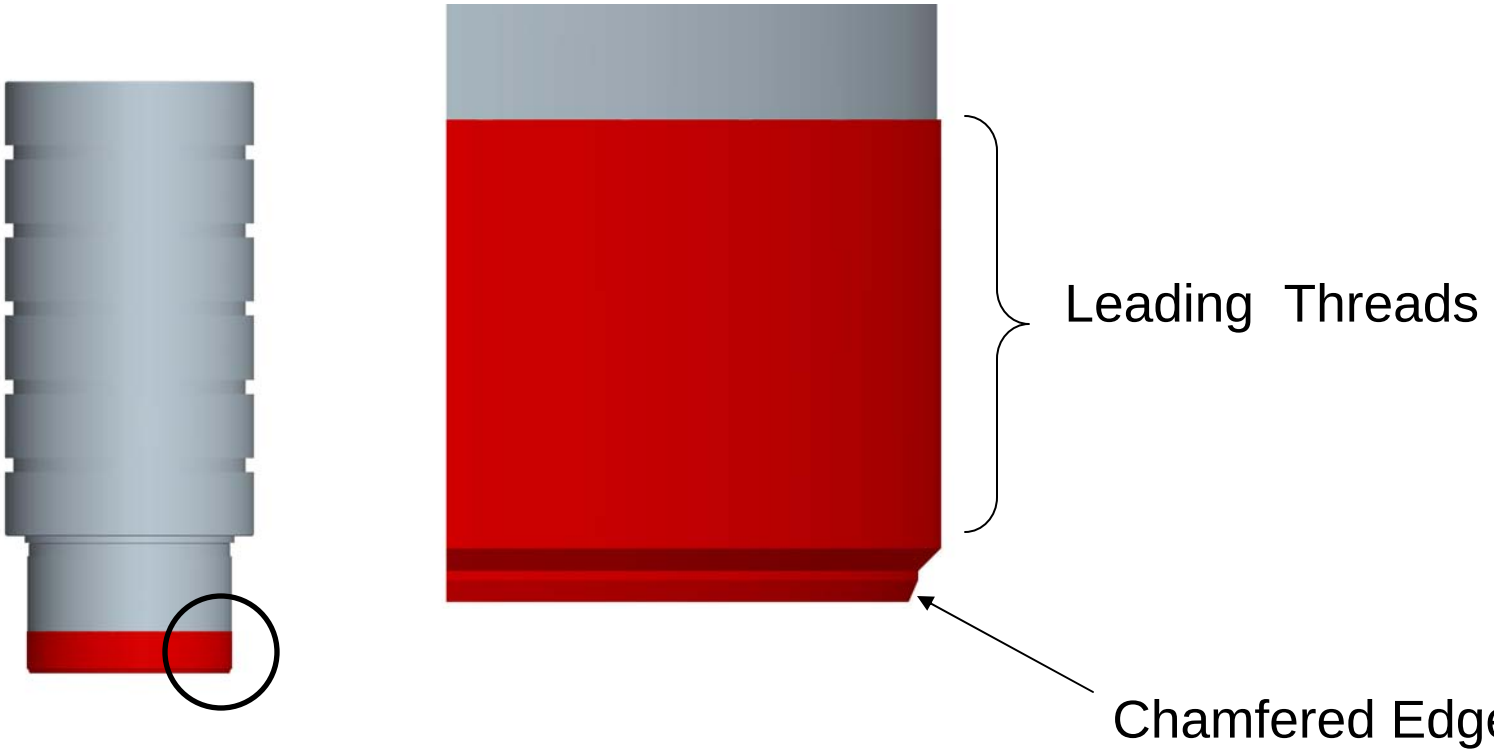
Design and Development

- Press-loading 120mm tank warhead with PAX-3.
- Case extension holds HE powder.
- Threaded joint.
- Barrier to prevent HE extrusion into thread zone.
  - sealant, o-ring, gasket (non-fixed)
- Polyurethane component provides a perfect seal.



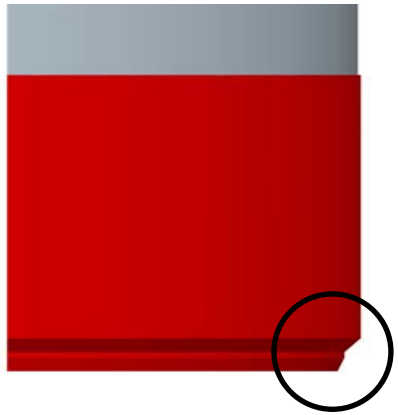
Design and Development
Urethane Thread Barrier

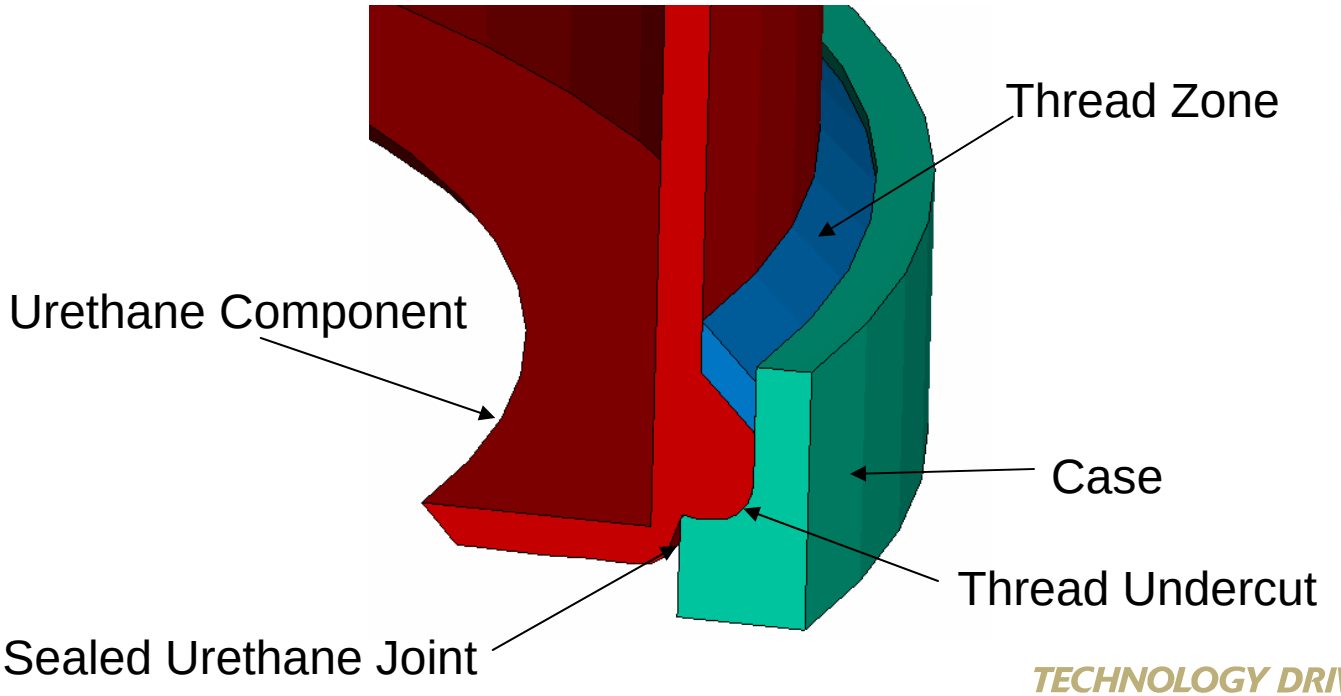
- Two features : Chamfered Edge and Leading Threads.



Design and Development
Urethane Thread Barrier

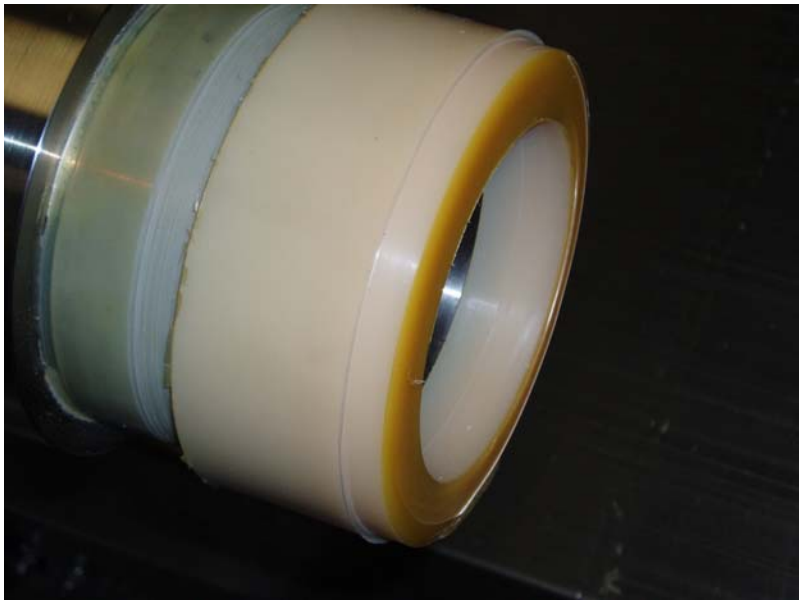
- FEA used to optimize design.
- Subsequent design improvements.
- Excellent results: Zero flash and clean threads.



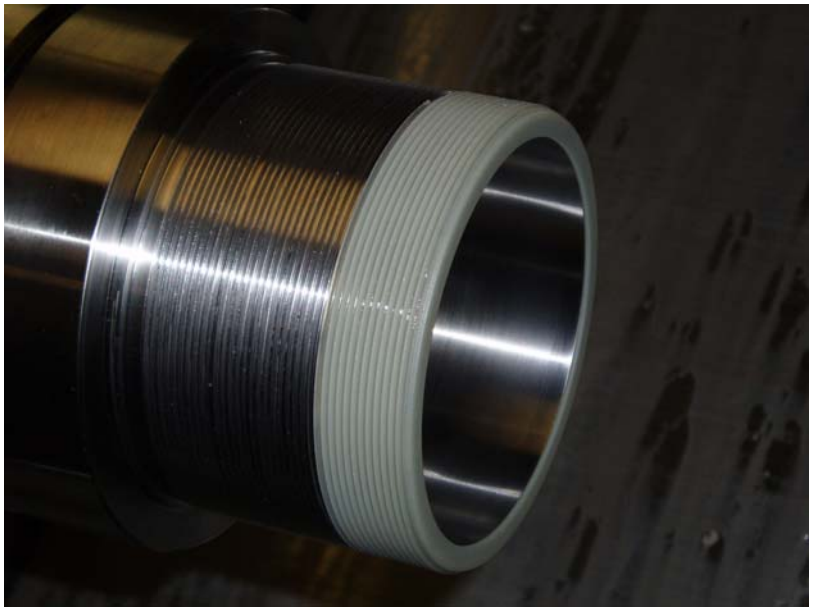


Design and Development
Casting and Machining

- Casting Process: hardness, lubricity, color, anti-static, etc.
- Machining Issues: varied and difficult, but not insurmountable.



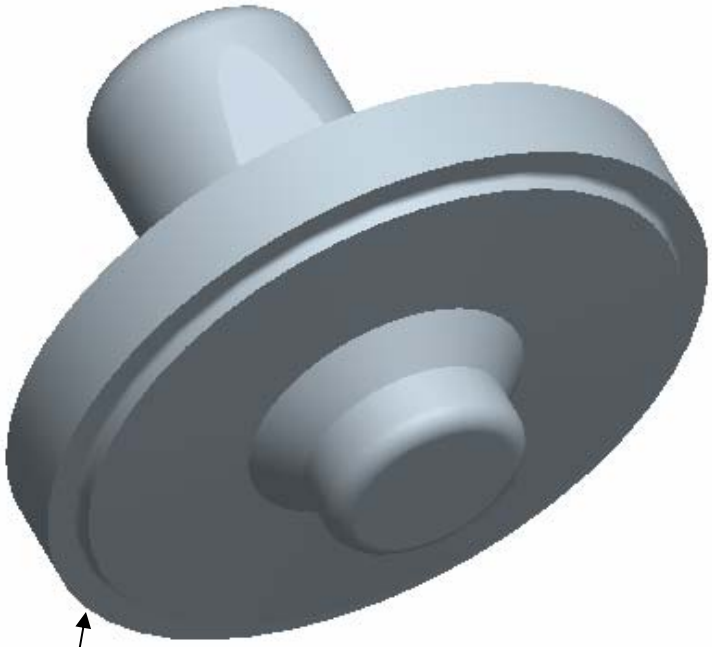
Urethane cast onto steel substratum



Finished part with threads.

Design and Development
Finish Punch Guidance

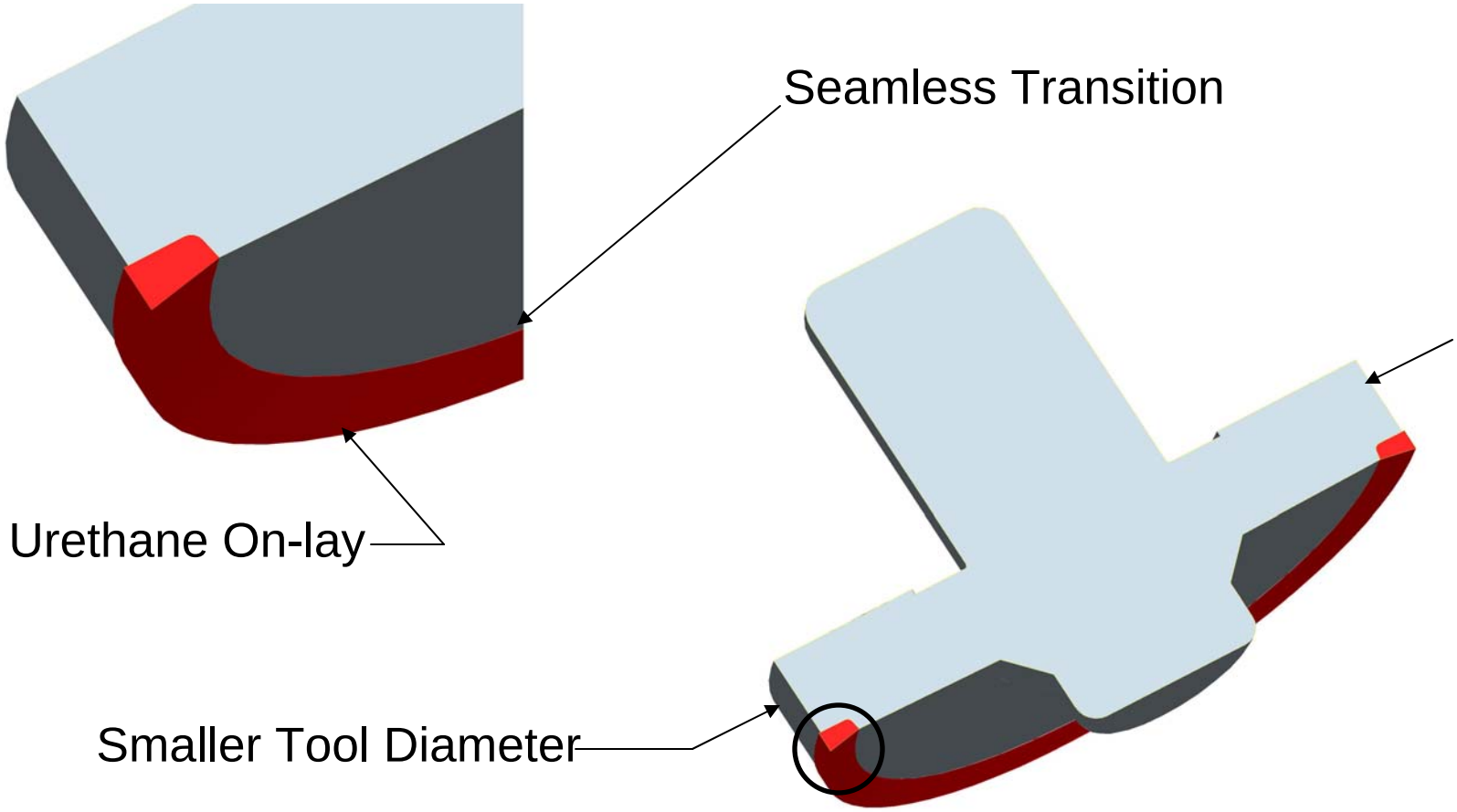
- Stack of tolerances increases hazard of tooling impingement.
- Polyurethane component designed to guide punch through the pressing stroke.
- Substratum machined leaving 0.050” finish stock.
- Final machining of steel and urethane



Machined Substratum

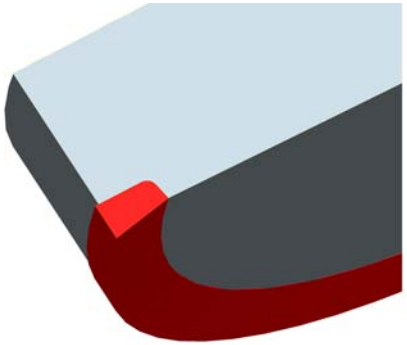
Design and Development

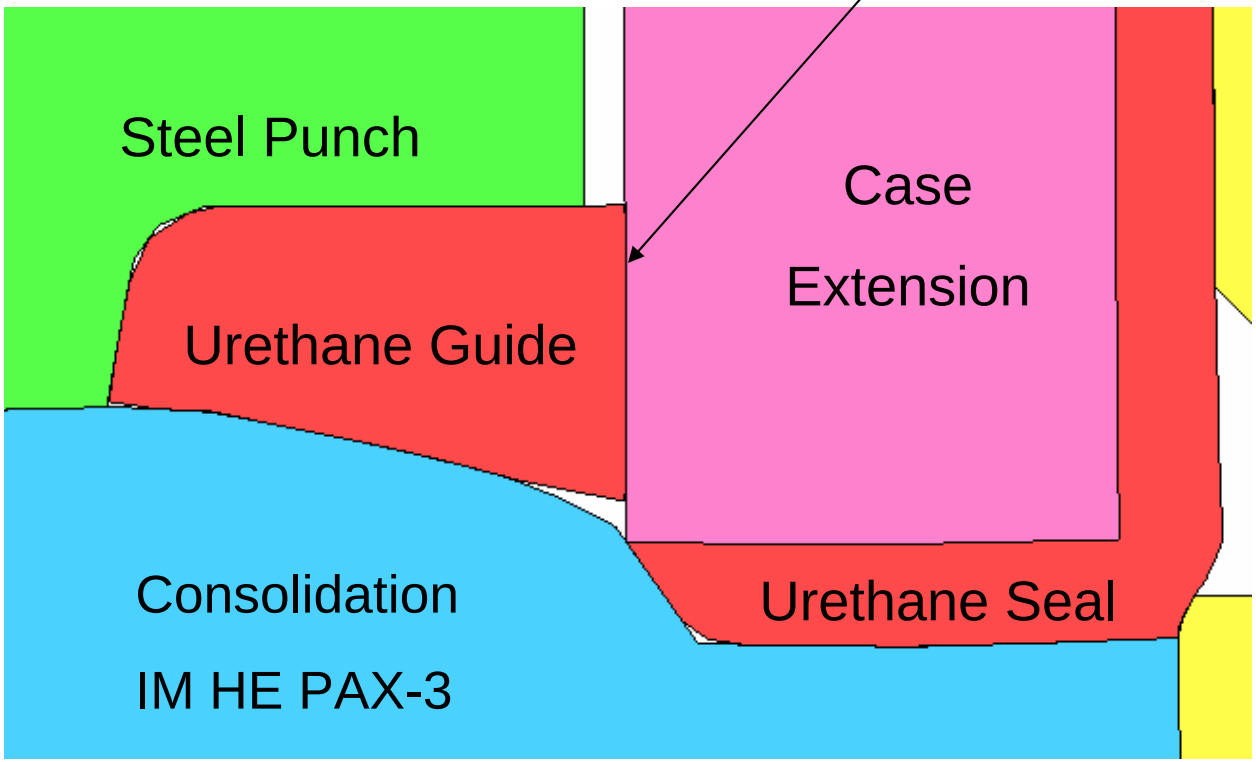
Finish Punch – Guidance Component



Design and Development
FEA Results to Inert Trials

- Inert trials show excellent results.
- Typical pressing parameters
- Shallow indentations from granules.
- No flashing or tear-away or tool damage.





Design and Development
Punch Casting and Machining

Cast Urethane on steel substratum

Finished punch face with urethane component.

Advantages

- Easily bonded to steel tooling.
- Easily molded and machined.
- Can be formulated for static dissipation.
- Non-sparking
- Working temperature range: -40°F - 160°F
- Behaves as incompressible hydraulic fluid.
- Volume unchanged under load.
- Deforms under a load
- Highly resilient
- Unlimited geometry
- Sacrificial and renewable
- Low friction against steel
- Compatible with HE PAX-3 (*All combinations of HE formulations and urethane formulations should be tested for compatibility.*)

Summary

- Polyurethane has unique characteristics that enable designers to incorporate cast components into steel tooling.
- Design process benefits from FEA and modeling tools.
- Fabrication process is controllable.
- Current application using urethane thread barrier and punch guidance to press-load 120mm tank warhead case.
- Initial trials with inert powders show excellent results.
- Polyurethane being considered for different tooling needs:
  - O-rings
  - Punch Facing
  - Centering and Nesting Devices