Polyurethane Press Tooling Components

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Background

- Inadvertent tooling damage
- Dynamic conditions
- Tool impingement
- Tight tool clearances

ARDEC is developing a solution using high-solids polyurethane.
- A-2 Tool Steel
- 56-58 RC Hardness
- 8 Micro-finish

Flat Contact Surface

Ram Extension

Ram

Punch

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

Solution: Replace the sharp leading edge with high durometer polyurethane.
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.
75D Durometer Polyurethane
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.
Two features: Chamfered Edge and Leading Threads.
- FEA used to optimize design.
- Subsequent design improvements.
- Excellent results: Zero flash and clean threads.
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.
- 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
Smaller Tool Diameter

Urethane On-lay

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