Lessons Learned from Ultra High-Strength Steel Blanking

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Goal & Approach

- To study UHSS blanking cutting force, edge quality and edge stretchability (flat, 15 mm, and 30 mm “mountain road” punches, or 0, 2 & 4 deg.)
- Blanking with one female blanking die & three blanking punches for 3 UHSS materials (780, 980, 1180 MPa) and draw forming
Point 1 to 6 are the locations of potential edge cracking
AB is the first touchdown flat section of the punch
CD is the last touchdown flat section of the punch
MR15= 15 mm shear; MR30= 30 mm
Clearance of 10% based on 1.47 mm sheet thickness
Blanking Die Design

14 rubber springs with total holding force of 24.2 tons

Enough for UHSS blanking?
Reduce AHSS cutting peak force in half
• Less cutting noise
• Less snap-through impact damage to die/press
• Less die / press deflection
• Blank 5 pieces; draw form 4 panels
Draw Forming Panel

Baseline sheet thickness $T_0 = 1.47$ mm

Draw die binder force: 1200 psi on cushion

16 hydraulic cylinders $D = 100$ mm

R_tool = 225
R_tool = 300
R_tool = 262.5
R_tool = 150

Typical Punch section:
$H = W = 75$ mm
All $r = 5.6$
Draft angle = $10^\circ$
Edge Thickness Measurements

Sensor contact head D = 5 mm
Measure along panel edge
Edge Thinning

Measurement points space: 5 mm near the crack / necking, 10 mm in no-crack / no-necking zones.

Lightly stoned to highlight V-shape necking
Problems

- Inconsistent edge thinning limit
- More investigation needed
Edge Defects

How to identify the root cause? Material issue? Die issue?
Punch Swinging

Multiple horizontal punch-sheet contact during cutting
Die Edge Issues

Die edge checked by a USB Microscopy

Welding defects

MR15 punch

Die edge chipping

Edge chipping

MR15 punch
One piece D6510 casting -> J-groove cutting -> M2 welding -> NC cut

- NC milling (large chord deviation)
- Unknown clearance after assembly
- Off center load and unbalanced horizontal force
Blank Rotation

Blank rotation before or during cutting & rubbing with punch side
Edge Hardness (shear damage)
Lesson Learned

• Die material, design & manufacture
  - avoid welding & rubber springs
  - avoid unbalanced off-center/horizontal force
  - shear angle limit
  - reduce chord deviation in NC cut
  - punch side polishing/grinding/coating
  - reduce die deflection/movement

• Die assembly accuracy
  - clearance measurement & control
  - improve punch/die alignment & guiding

• Die edge maintenance
  - sharpness
  - clean punch side galling