The Advancements of Force Generating Technologies for Hot and Cold Forming Applications

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HYSON Metal Forming Solutions
Introduction

- Fuel Efficiency Standards
- Vehicle Light Weighting
- Safety Standards
Introduction

- Cost of Manufacturing/ Vehicle
- Keep work in USA
- Heavy work load/ High Goals / Big Responsibility
Forming Technology Options

**HOT Forming**
- Heat Steel
- Transfer into Press
- Stamp Part
- Cool Part

**COLD Forming**
- Insert MTL into Press
- Stamp Part
Forming Methods

• **HOT Forming** Boron Steel
  - Heat up/ transfer into die/ Stamp Part/ Cool Part
Forming Methods

- HOT Forming
Forming Challenges

- **HOT Forming** Boron Steel
  - Large investment and energy usage
  - Furnace requirements, time to heat up
  - Transfer between furnace and press
  - Cooling of material and time
Forming Methods

• **COLD Forming** High Tensile Strength Steel
  - Insert material into die/ Stamp Part
• **COLD Forming** High Tensile Strength Steel
  - Part Quality: wrinkling/tearing
  - Inadequate forces
  - Inconsistency in material batch
  - Friction/ Heat
Forming Challenges

• **COLD Forming** High Tensile Strength Steel
  - Part Quality; wrinkling/tearing
  - Inadequate forces
  - Inconsistency in material batch
  - Friction/Heat
Forming Challenges

- **COLD Forming** High Tensile Strength Steel
  - Part Quality; wrinkling/tearing
  - Inadequate forces
  - Inconsistency in material batch
  - Friction/Heat
Forming Challenges

- **COLD Forming** of High Tensile Strength Steel
  - Part Quality; wrinkling/tearing
  - Inadequate forces
  - Inconsistency in material batch
  - Friction/Heat

<table>
<thead>
<tr>
<th>Technology</th>
<th>AIR</th>
<th>NITROGEN</th>
<th>HYDRAULIC</th>
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<tbody>
<tr>
<td>Pressure</td>
<td>100 psi</td>
<td>2000 psi</td>
<td>4000 psi</td>
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Forming Challenges

- **COLD Forming** High Tensile Strength Steel
  - Part Quality; wrinkling/tearing
  - Inadequate forces
  - Inconsistency in material batch
  - Friction/Heat
Inconsistency in Material Batch
Inconsistency in Material Batch

Binder height & force

Zone 2 height

Zone 3 height

Zone 4 height

Zone 2

Zone 3

Zone 4
Forming Challenges

- **COLD Forming** High Tensile Strength Steel
  - Part Quality; wrinkling/tearing
  - Inadequate forces
  - Inconsistency in material batch
  - Friction/ Heat
Successfully formed at using pulsating BHF=85 kN to 20 kN (5 pulses/sec)

Fracture using constant BHF=85 kN

Press output
Friction Heat

Friction force

(N) 200

f 300N stat./0N pul.

e 280N stat./20N pul.

d 260N stat./40N pul.

c 240N stat./60N pul.

b 220N stat./80N pul.

a 200N stat./100N pul.

speed: 100mm/s, die: 1.2379,
sheet: ZSTE 260, frequency: 12Hz,
lubrication: non
Forming Challenges

• **Hot Forming** Boron Steel
  - Large investment and energy usage
  - Furnace requirements, time to heat up
  - Transfer between furnace and press
  - Cooling of material and time
Direct hot stamping process

Coil → Blanking → Furnace → Press forming

Cooling
Hot Forming Tooling
Hot Forming

• Maximizing Cooling Time
Hot Forming

• Maximizing Cooling Time
Heat transfer coefficient $h_{\text{cond}}$ in W/Km² as a function of contact pressure $p$ in MPa. The graph shows a linear increase with increasing contact pressure, with values ranging from approximately 0 to 5000 W/Km². The data is from Lechler et al., 2009.
- Force Options
Hot Forming
• Graph From Controller
The Right Tool

• Force Options

N2 Gas System

Delay System

Servo Hydraulic System
Conclusion

Thank You, Questions?
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