Advanced Stamping for High Strength Steels

J.P. McGuire
Chrysler Group LLC.
Advanced Stamping Manufacturing Engineering

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Chrysler Material Selection

Die Engineering for AHSS

Die Process

Full Cycle Simulation

Die Design for AHSS

Die Materials/Coatings

Beyond 2014

Opportunities

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Chrysler Group Material Selection

2005 Grand Cherokee

2011 Grand Cherokee

2011 Chrysler 300

New Dodge Dart

29% HSS

50% HSS

60% HSS

68% HSS

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50% High Strength Steel

High Strength Steel: YS > 200 MPa

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High Strength Steel: YS > 200 MPa

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Largest TRIP590 Application in Production

2011 Dodge Charger
BIW Material Usage

High Strength Steel: YS > 200 MPa

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High Strength Steel: 
YS > 200 MPa

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Die Process for AHSS

Draw

Trim

Pierce/Restrike/Flange

New Methods to Control Springback

Stricter Product Radii Limits

Stricter:
- Trim Angle Standards
- Cutter Clearance
- Minimum Shear Requirements

Stricter:
- Pierce hole angle maximums
- Restrike only for qualifying surface, not “reforming”

On-going improvement working with product engineering, die shop, and stamping plant teams to develop best practice

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Large radii

Gradual depth / LOL transition

Open walls

Bead metal on flange (utilization observation)
DP 600

Overcrown Surface Morph

Springback & compensate

Final detail panel meets GD&T tolerance

Springback & compensate

D2-14 Direct Trim, PRC pilots.

D3- Direct Trim and re-strike

Springback & compensate

D4- Direct finish trim & separate parts.

Springback & compensate

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Negative values mean that the die surface is morphed in +Z draw axis direction.
Example. AHSS Die Design Section

- Increased Rib Thickness in Working Areas
- Enhanced Thrust Containment
- Use of Separate Details in Working Areas
- In Some Cases Heavier Duty Standard Components (i.e. punches, nitro cylinders, cams, etc.).
### Table 11. Example images of linear static FEA results

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<th>Optimized Concept</th>
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<td>– handling</td>
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</table>
Dodge Dart AHSS Parts

Draw Die

Trim Die

0.80 mm DP600 Floor Pans

Chrysler “A” Standard (Base Materials and Sections)

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Dodge Dart AHSS Parts

Progressive Die

Chrysler “D” Standard

1.6 mm DP980

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Future AHSS Die Design (Extreme Cases)

+ 2.0 mm DP 600, 780
+ 1.8 mm DP980
Sharp “V” part geometry
Coatings for Stamping Dies

Traditional Die Coatings

• Chrome Plate (Class A Panels)
• Ion Nitride (Non AHSS Inner Panels)
This condition can cause:

- Poor formability (wrinkling)
- Poor dimensional properties
- Customer quality concerns

Class A surface quality suffers, also increased potential panel scrap

Bead wear premature, causing panel run out
Coatings for Stamping Dies

New Coatings Required for AHSS

Current Chrysler Standard

- PVD – Physical Vapor Deposition
- D2 Tool Steel
- Stricter Metallurgical and Heat Treat Requirements
- Nitriding first with absence of white layer

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## Die Insert Coatings for AHSS

### Physical Vapor Deposition
- **Deposition**: $T = 400-950 \, ^\circ F$
- **Cycle Time**: 6-8 hours
- **Total Process**: 3-5 Days

### Chemical Vapor Deposition
- **Deposition**: $T = 1300-1900 \, ^\circ F$
- **Cycle Time**: 18 – 24 hours
- **Total Process**: 5-7 days

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Die Insert Coatings for AHSS

CVD-TiC
0.08mm Growth

PVD-CrN
No size change

White light scanning used to verify dimensional Change

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Chrysler is currently studying Advanced Strength Steel with better combination of Strength and Elongation.

Projects in Chrysler

Steel Technology to Reduce Material Property Variation

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Future: Ever Improving Material Models Based on Production Data

Improved Material Property Behavior Laws

In Depth Characterization of Both Material & Die Behavior

Tensile Testing

FLC Testing

Thickness Change Influence

Material Direction Influence

Forming Speed Influence

Trimming Process Influence

Individual FLC Testing

Bend/Bend Back Influence

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Small AHSS parts require higher tonnage than previous.

Strong Case for Larger Tonnage Presses (i.e. +3000 tons)

Lower materials utilization ($$$)

Enhanced part guidelines for press loading (improved simulation accuracy)

New Preventative Maintenance Requirements for AHSS

Part temperature

Enhanced part sensing

Decoiling/leveling/front of line

Training on new methods