Better Tool Steels for Better Dies
Balanced Properties for Optimum Performance

Ed Severson – Technical Manager
Bohler – Uddeholm United States
Introduction

• Bohler – Uddeholm Introduction
• Advanced High Strength Steels
  – Rapid Growth in Applications

• Balancing Act
  – Tooling Properties
  – Casting Properties
Tool Steels
Specialty Steels
Aircraft Alloys
Automotive Steels

Worldwide Distribution
And Manufacturing
Bohler – Austria
Uddeholm – Sweden
Villares – Brazil
Buderus – Germany
BUSMI - Virginia

www.autosteel.org
What can be expected with AHSS?

As much as possible

Consumer goods - Appliances

Tooling Solutions for advanced high strength steels Selection Guide - Uddeholm and SSAB
Advanced High Strength Work Materials

Formability, $A_{80}$ (%)

- IF
- Mild Steel
- Bake Hardenable
- HSLA
- Trip-steel
- DP-steel
- Mart. steel

- 29 MPa (ksi)
- ~125HB
- ~180HB
- ~22HRC
- ~33HRC
- ~38HRC
- ~44HRC

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Balancing Act – High Strength Materials

Hardness

Tensile Strength
Yield Strength

Ductility

Stamping
Forming
Blanking
Bending
Drawing
Balancing Act – AHSS’s and Tooling

AHSS’s
High Tensile
High Yield
High Ductility

Tooling
Larger Forces
Greater Shock
Higher Wear
More Galling

All the positive properties of AHSS’s, decrease tooling life
Balancing Act – Optimizing Performance

• AHSS’s relatively new
  – TESTING CRITICAL
  – Each material different
UHS Work Material

Wear Mechanism
Docol 1400DP
6% die clearance

Number of blanks made

Punch wear ($\mu$m$^2$)

- (S7) - 58 HRC
- (D2) - 58 HRC
- P/M 4%V - 58 HRC

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UHS Work Material

Wear Mechanism after 140,000 Strokes - Docol 1400DP

AISI S7  |  AISI D2  |  PM 4% Vanadium

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Punch wear after 200 000 strokes
Hardness 60 HRC, 10% cutting clearance

VANADIS 4 5675 µm²
VANADIS 6 6760 µm²
AISI D2 16260 µm²
8% Cr (29730 µm²)
1200 MPa – Work Material

PM 4% V

PM 4% V Improved

PM 6% V

8% Cr

AISI D2

Punches after 50 000 press strokes
Balancing Act – Tooling Materials

- Conventional Metallurgy Grades
- Spray formed Metallurgy Grades
- Powder Metallurgy Grades
- ESR Grades

- S7
- 5% Cr ESR
- A2
- 4% Van PM
- 7% Van SF
- 6% Van PM
- 8% Cr ESR
- 4% Van SF
- 10% Van PM
- D2
- 10% Van SF

Chipping Resistance vs. Wear Resistance
Balancing Act – Optimizing Performance

• AHSS’s relatively new
  – TESTING CRITICAL
  – Each material different

• “Old” tooling rules do not apply
  – Not simply wear or toughness but combination

Optimum performance not equal to optimum costs
Balancing Act - Castings

AHSS's

All the positive properties of AHSS’s, decrease tooling life

Castings

Larger Forces
Greater Shock
Higher Wear
Castability
Weldability
Balancing Act - Castings

Increasing Weldability

Increasing Chipping Resistance

Increasing Wear Resistance

SAE 0050A Cast

Carmo Wrought

Carmo Cast

M2 Wrought

A2 Wrought

D2 Wrought

Caldie Wrought

Caldie Cast

S7 Wrought

A2 Cast

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Tool Steel Casting Process - Video
Tool Steel Castings - Advantages

• **Controlled Melting**
  – Certified chemistry control
  – Controlled atmosphere melting for cleanliness
  – Shorter melt time (greater surface area)
    • DOE potential energy savings

• **Use of Tool Steel Alloys**
  – Upgraded properties from traditional materials
  – Wide variety of available materials
    • (With known properties)
Balancing Act – Summary

• AHSS’s force break from “Norm”
  – S7, D2, Casting Alloys not ideal

• Best Performance
  – Toughness and Wear Combination

• Testing is Key
  – Each new AHSS creates a new set of parameters
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Thank You - Questions?