

TOOLS SOLVING PROBLEMS AUTOMOTIVE A NEW WAY OF THINKING HIGH PERFORMANCE DUCTILITY
ECONOMY THE WORLD'S LEADING SUPPLIER OF TOOLING MATERIALS PARTNERSHIP HARDNESS
TOUGHNESS STRENGTH INNOVATION KNOWLEDGE UNDERSTANDING MACHINABILITY TRUST
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Tooling Solutions for Blanking and Forming Advanced High Strength Steel Sheet Materials

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The use of Advanced High Strength Steel (AHSS) is steadily increasing

Automotive

- Lower weight – reduced fuel consumption
- Improve/Maintain safety – higher strength necessary

General engineering

- Smaller/thinner designs
- Lower weight

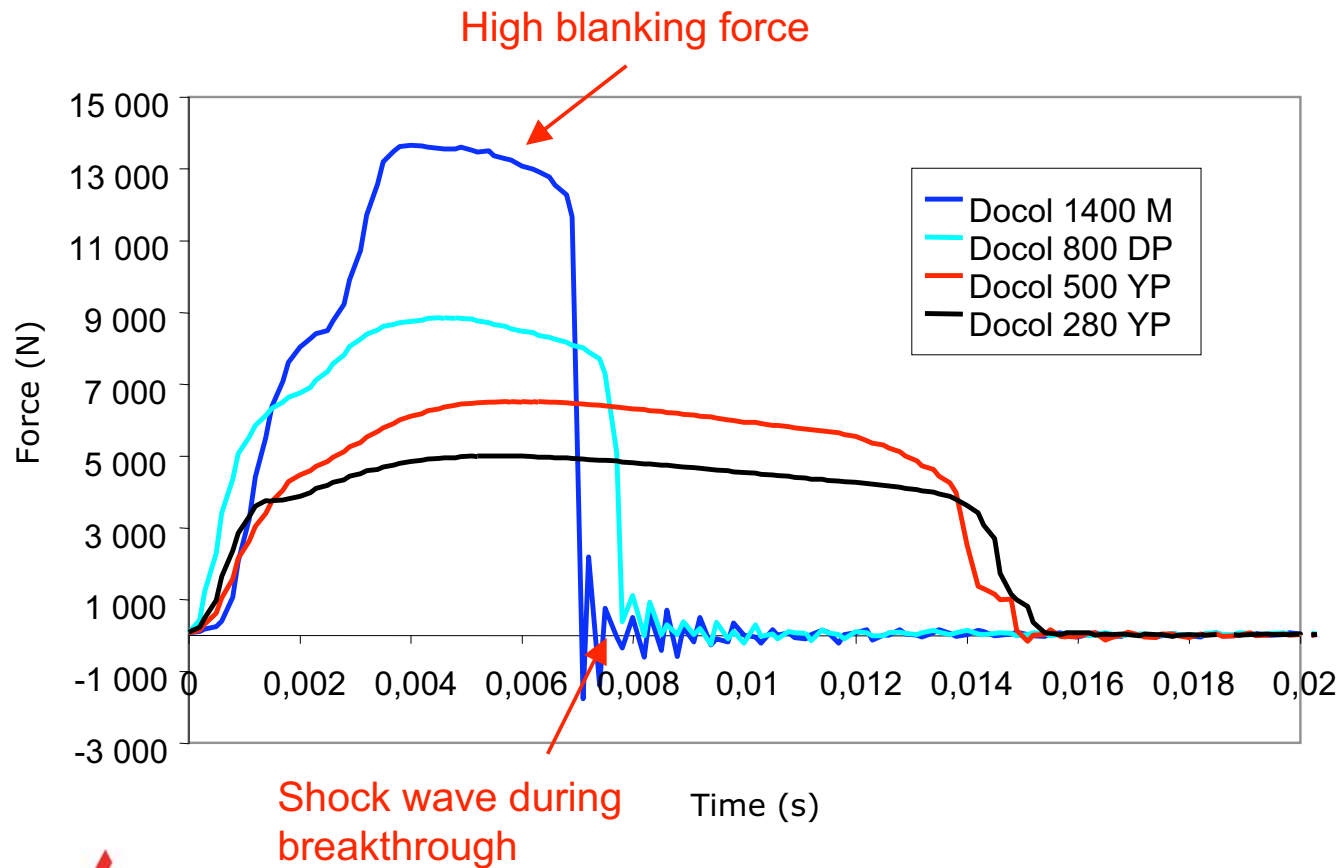
The presswork tooling environment

Influence of increasing sheet strength

Sheet type	R _m MPa		
Soft - mild	< 330		
High strength	330 - < 570		
Extra high strength	570 - < 800		
Ultra high strength	> 800		

The presswork tooling environment

Influence of sheet material strength on blanking force



Tooling requirements for blanking AHSS sheet

High chipping and cracking resistance

- Tool steel with high fatigue life to prevent premature crack initiation
- Very good surface finish on tool – bad surface finish reduces fatigue strength
- High compressive strength (working hardness)

N.B.

A good surface finish is always something to aim for and it is particularly important here

The presswork tooling environment

The most common tool steels for blanking, forming, trimming and calibration dies

5% Cr steel	AISI A2	W.-Nr. 1.2363
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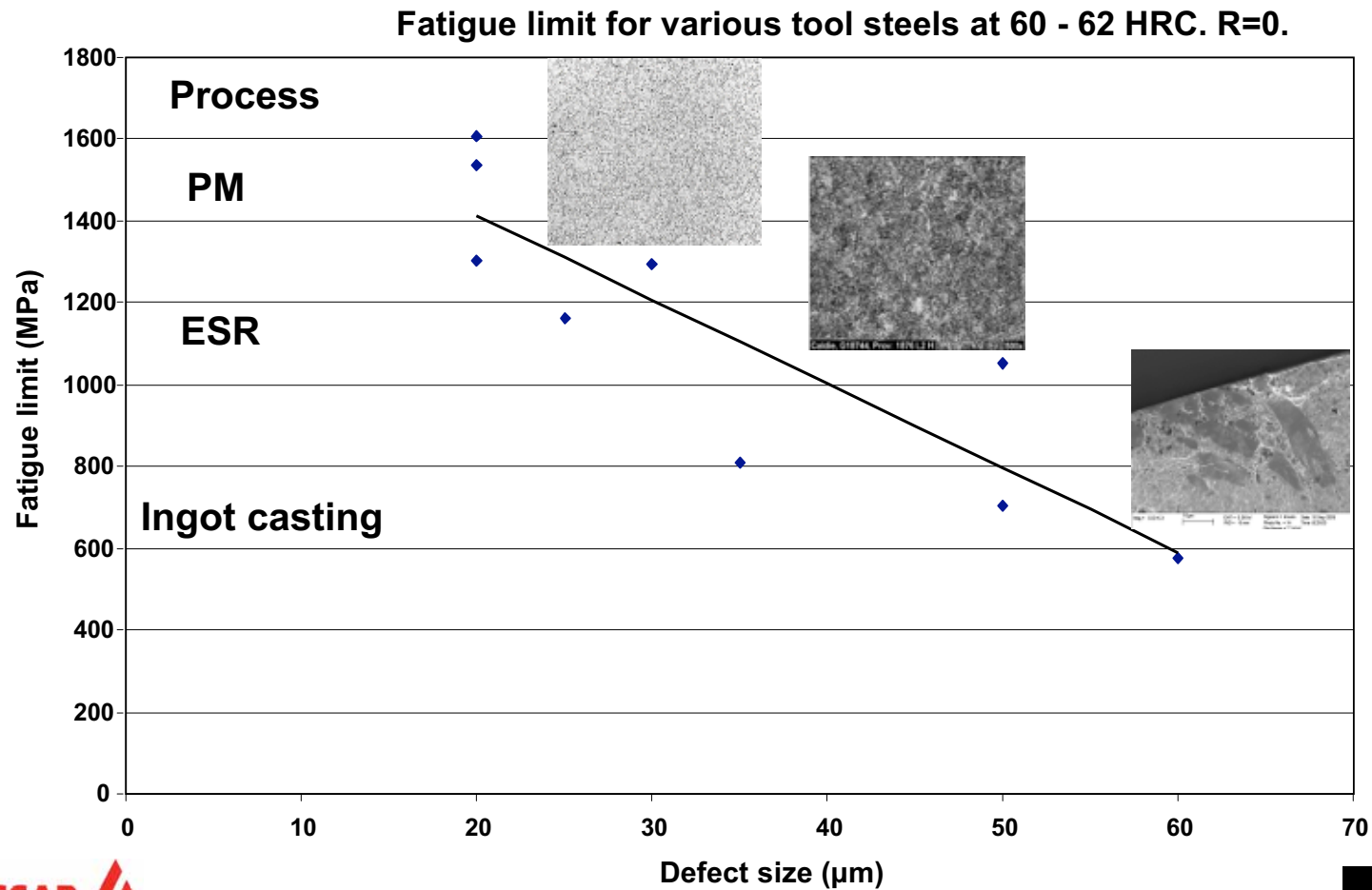
12% Cr steel	AISI D2	W.-Nr. 1.2379
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These grades are not always suitable for demanding presswork applications like those involving higher strength steel sheet materials

Why? Because a higher fatigue life is needed

What governs fatigue life?

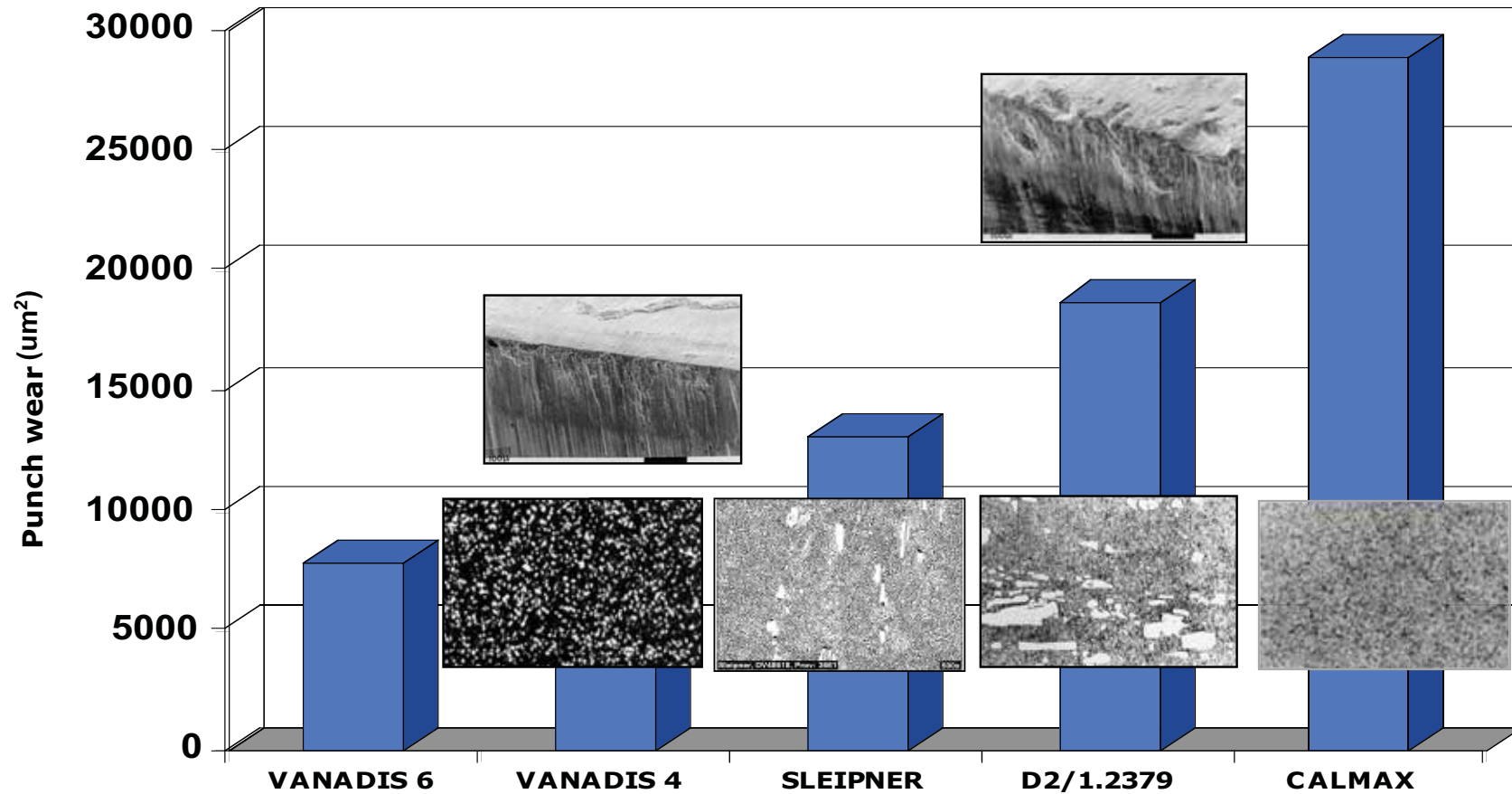
Fatigue limit for 2×10^6 cycles



Blanking of Docol 1400 M, t= 1mm

Punch wear after 200 000 strokes

Tool hardness: 60 HRC; CALMAX 58 HRC



Methods that can improve ductility and chipping resistance in steel

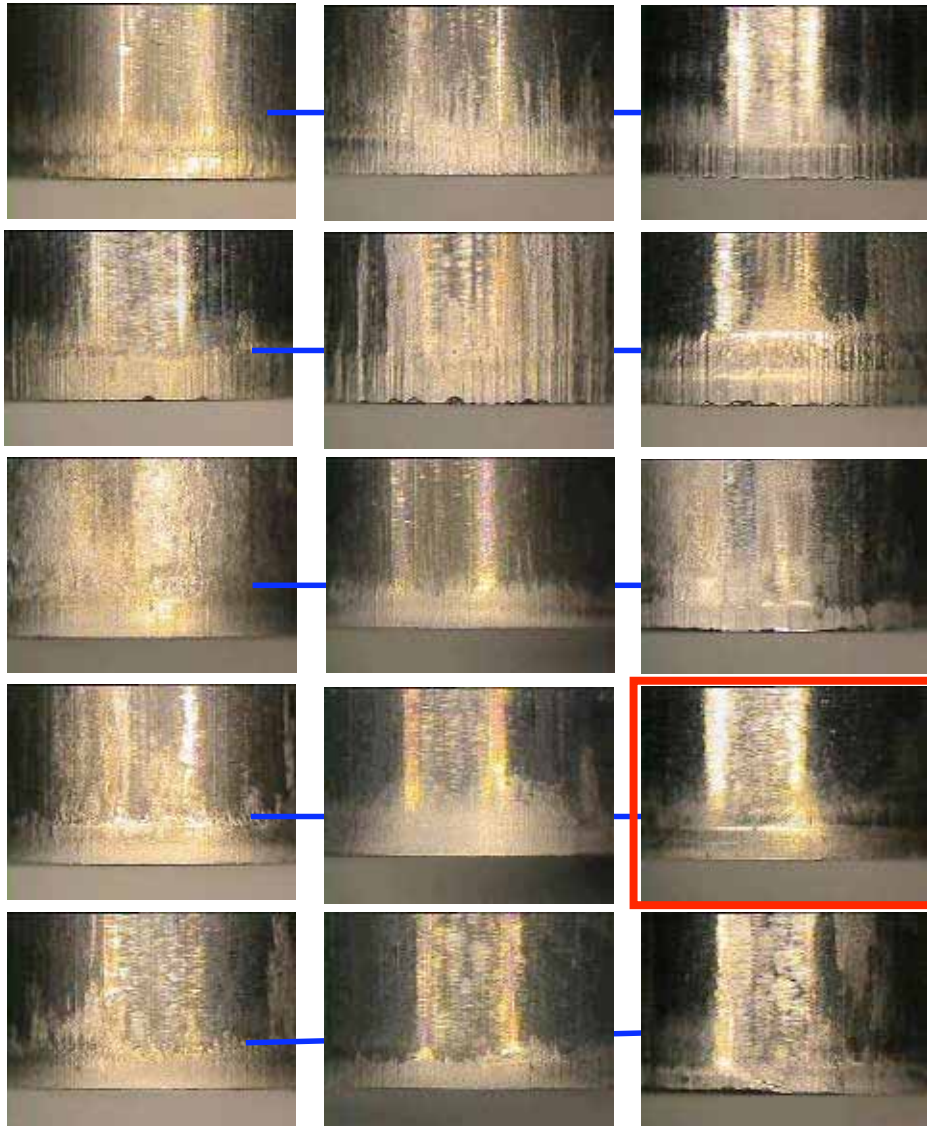
- New steel developments – analysis
 - Matrix type steel
 - Steel with modified carbides
- ESR – to improve cleanliness

Tool steel development – modified carbide type

Trip 700

CP-W 800

MS-W 1200



Blanking of AHSS, $t=1,8$ mm

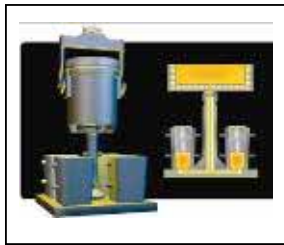
Edge appearance after 50 000 strokes

Limiting tool steel failure mechanisms

Uddeholm Grade	Abrasive wear	Adhesive wear/galling	Chipping
ARNE	Short blue bar	Short blue bar	Short blue bar
RIGOR	Short blue bar	Short blue bar	Short blue bar
SLEIPNER	Medium blue bar	Medium blue bar	Medium blue bar
SVERKER 21	Medium blue bar	Short blue bar	Short blue bar
SVERKER 3	Long blue bar	Short blue bar	Short blue bar
CALMAX/CARMO	Short blue bar	Medium blue bar	Long blue bar
CALDIE	Short light blue bar	Short light blue bar	Short light blue bar
VANADIS 4	Short orange bar	Long orange bar	Long orange bar
VANADIS 4 Extra	Short orange bar	Long orange bar	Long orange bar
VANADIS 6	Medium orange bar	Medium orange bar	Medium orange bar
VANADIS 10	Long orange bar	Medium orange bar	Short orange bar
VANADIS 23	Short orange bar	Medium orange bar	Short orange bar

Tool steel development - matrix type steel + ESR

Uddeholm Caldie



+



Makes Caldie a very useful steel for blanking & forming AHSS

- ✓ Very good chipping and cracking resistance
- ✓ Very good through hardening properties – can reach 60-62 HRC after high temperature tempering
- ✓ Very good combination of chipping / cracking resistance and compressive strength
- ✓ **An excellent substrate for all types of coatings**

Uddeholm Caldie

UDDEHOLM grade	Abrasive wear resistance	Adhesive wear resistance	Microcrack initiation resistance		Plastic deformation resistance
			Chipping	Breakage	
Sverker 21					
Caldie					

Very good combination of these properties

Application experience Caldie (1)

Company: Linde Maskiner AB, Sweden
Component: truck shock absorber member
Tool type: cold forming die
Tool dimensions: inserts 400x180x120 mm
Work material: mild steel Domex 350 YP t=4 mm (HSLA steel)



Application experience Caldie (1)

Results

Steel and surface coating	AISI D2 CVD TiC/TiN	CALDIE CVD TiC/TiN
Hardness	58-60 HRC	61 HRC
Parts produced	1-100	> 100 000
Production rate	120 000 per annum	
Failure mechanism(s)	cracking	still running
Comments		

Summary

- * We have seen that the demands on the tool steels used in tooling for AHSS materials are very high – much higher than for the softer grades
- * The old generation of presswork tool steels does not give acceptable performance for blanking and forming of advanced high strength steels
- * A high tooling quality is necessary for blanking and forming the AHSS materials

Uddeholm Tooling and SSAB Tunnpååt– a Unique Technical Cooperation

- New product designs demand new production materials
- New production materials demand new tooling materials
- Cooperation between production material manufacturer and tool steel manufacturer
- Development of common solutions for production material and tool material

