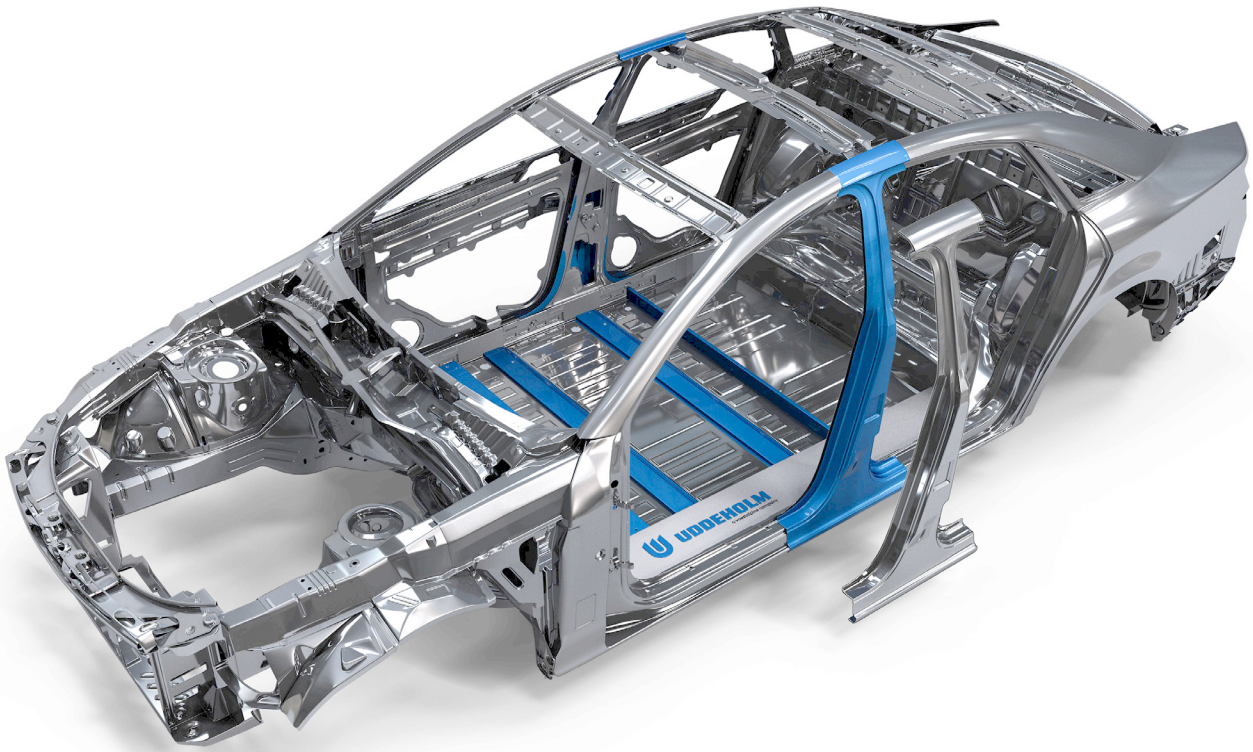
Uddeholm tooling solutions for

ADVANCED HIGH STRENGTH STEELS



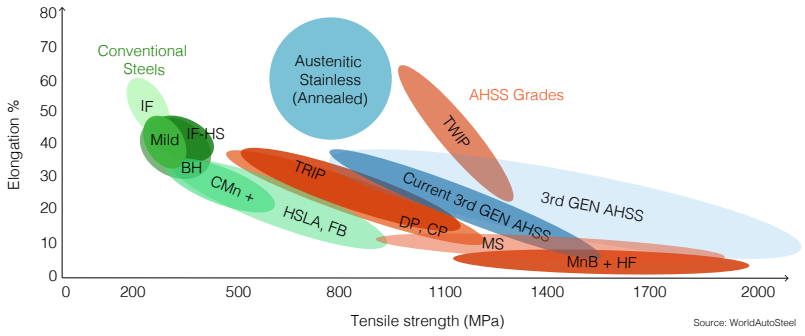
UDDEHOLM
a voestalpine company

WHAT IS AHSS?

Advanced high strength steels (AHSS) are work materials with tensile strengths ranging from ~780 MPa and higher.

The demands on tooling for AHSS are the highest of any blanking and forming application. Due to the high strength causing higher cutting force, contact pressure and cyclic load, traditional wear mechanism as abrasive wear are moving towards more chipping, galling and plastic deformation.

In order to prolong tool life it is essential to use tooling material with sufficient resistance against these failures.



COMMON TYPES OF AHSS

Transformation Induced Plasticity (TRIP)

The structure consists of austenite and martensite. Austenite for good formability, which is during forming transformed to martensite.

Dual Phase (DP)

The structure consists of two phases. Ferrite which is soft and sticky with good formability and martensite which is the harder phase that provides the material strength.

Martensitic (MS)

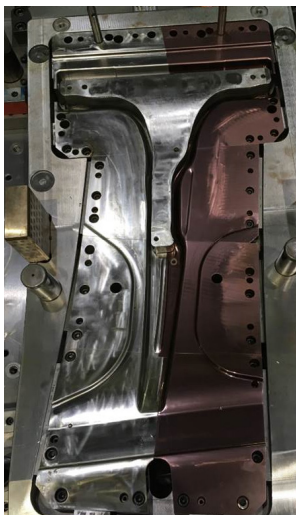
Fully martensitic grades contain only the hard phase. These grades have typically the highest strength.

Complex Phase (CP)

The structure consists of more than two phases. Different amount of martensite, ferrite, bainite and retained austenite gives different strength level and formability.

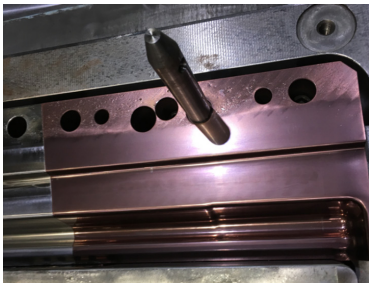
FORMING

Below is a tool after forming of 1400 B-Pillars made of a dual phase (DP) sheet with minimum tensile strength of 1180 MPa. Comparison is made between a traditional tooling solution and an optimal tooling solution.



Uncoated W.-Nr. 1.2379
Clear wear marks

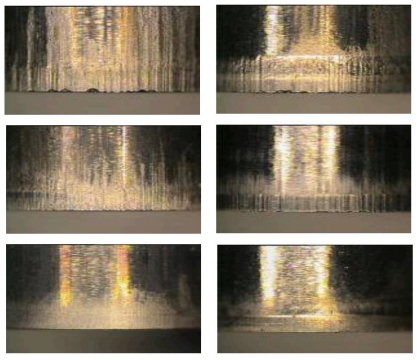
Uddeholm Caldie
+ Duplex VARIANTIC coating
No wear detected



TRIMMING AND PUNCHING

Influence of sheet material strength on punches edge appearance. The table shows that the chipping resistance of the tool material is of outmost importance. Other properties that inluence punch life are abrasive wear resistance and compressive strength.

800 MPa 1200 MPa



Punching of AHSS, t= 1,8 mm
Edge appearance after 50 000 strokes

STEEL GRADE	CHIPPING RESISTANCE
AISI D2/W.-Nr. 1.23749	
Uddeholm Sleipner®	
Uddeholm Vanadis® 4 Extra Superclean	

A complex phase (CP) sheet with minimum tensile strength of 1370 MPa. For higher strength sheets the risk of plastic deformation can be reduced by a duplex PVD coating.

Trimming tool after 10 000 cuts
Uddeholm Caldie, 61 HRC, + TiCN ultrafine
Plastic deformation without Duplex coating

Trimming tool after 100 000 cuts
Uddeholm Caldie, 61 HRC,
No plastic deformation with Duplex VARIANTIC coating

Enhanced wear resistance
Less chipping
Less microcracking

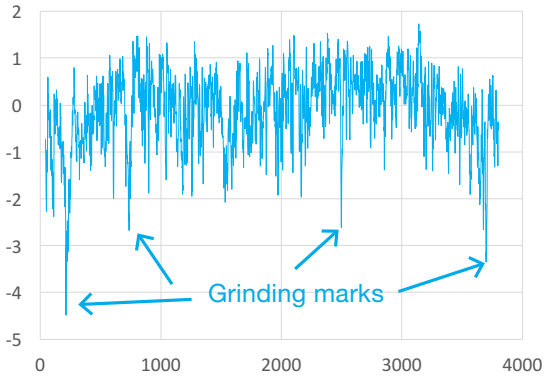
TOOLING QUALITY

Before coating the tool, the surface quality has to be adjusted to the needs of the application, especially in the active areas of the tool.

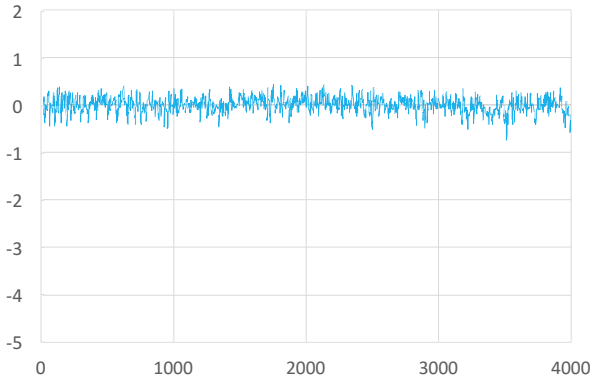
The active areas of the tool should be smooth and free from corrosion and white layers in order to obtain the best performance. After grinding, a typical surface finish of Ra~0.5 µm is obtained, which is not smooth enough for a high performance tool in cold work application. A rough surface (by e.g. grinding marks) may lead to inhomogeneous coating layers and cracks in the PVD coating. Thus, polishing to Ra <0.2 µm in active areas is recommended before a PVD coating is applied.

For critical applications, even finer Ra <0.05 µm. Furthermore, depending on the application, a post-treatment of the coated tool may be recommended and should be discussed with our local sales contact.

SURFACE

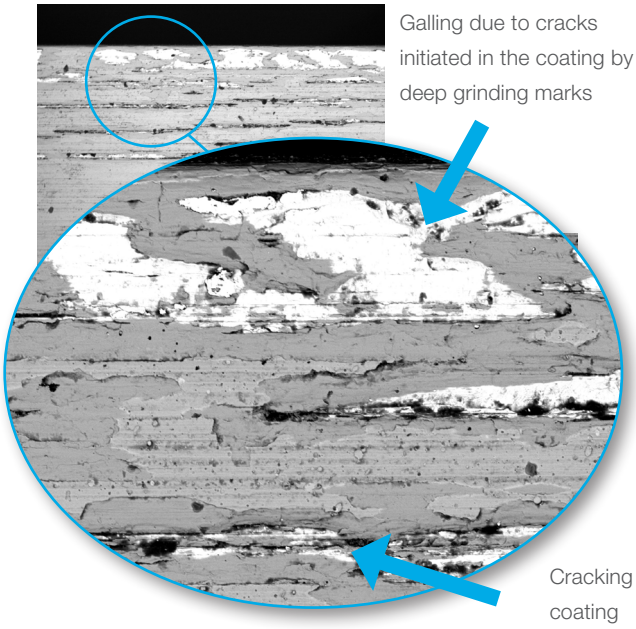


Surface profile with deep grinding marks, Ra=0.5 µm, Rz=4.0 µm



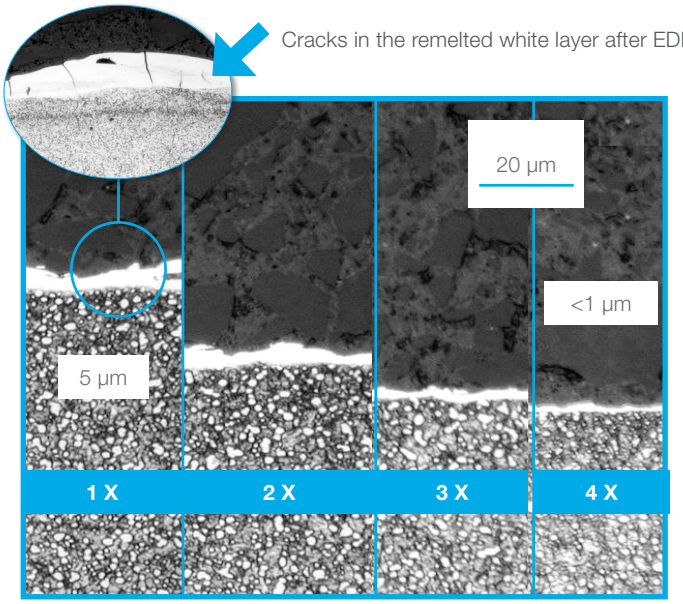
Same surface profile after polishing with #600 grit, Ra=0.1 µm, Rz=1.0 µm

CRACKING



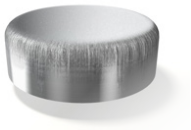
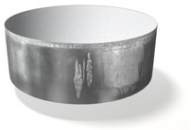
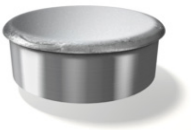
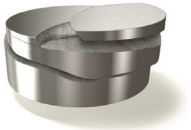
Galling due to cracks initiated in the coating by deep grinding marks

Cracking of coating



Heat affected surfaces from WEDM need to be removed and 3–4 passes are needed to reduce the heat affected zone that have small cracks and high stress level.

TOOL STEEL SELECTION FOR AHSS

WEAR TYPE	Abrasive wear	Adhesive wear/galling	Plastic deformation	Chipping	Breakage
					
POSSIBLE REASONS	• Hot rolled sheet • High carbon sheets • Electrical sheet • Oxidised sheet surface • Martensitic sheets	• Stainless sheets • Coated sheets • Thick sheets • Sheet steel grades containing austenite or ferrite	• High strength sheets • Thick sheets • Sharp corner to trim	• Complex design • High cyclic loads on tool	• Thin sections • Bigger tool parts • Long punches

STEEL GRADE	ABRASIVE WEAR RESISTANCE	ADHESIVE WEAR RESISTANCE	RESISTANCE TO PLASTIC DEFORMATION	CHIPPING RESISTANCE	RESISTANCE TO BREAKAGE
(W.-Nr. 1.2379/AISI D2)	■■■	■	■■■	■	■
Uddeholm Sleipner®	■■■	■■	■■■■■	■■	■■
Uddeholm Calmax®	■■	■■	■■	■■■■■	■■■■■
Uddeholm Caldie®	■■	■■■	■■■■	■■■■■	■■■■
Uddeholm Vanadis® 4 Extra SuperClean	■■■	■■■■	■■■■■	■■■■	■■■
Uddeholm Vanadis® 8 SuperClean	■■■■■	■■■■	■■■■■	■■■	■■■
Uddeholm Vancron® SuperClean	■■■■	■■■■■	■■■■■	■■■	■■■

NOT RECOMMENDED ■ OK ■■ GOOD ■■■ BETTER ■■■■ BEST ■■■■■

- Abrasive and Adhesive wear resistance can also be improved by a PVD coating.
- Plastic deformation resistance can in some cases be improved by a duplex PVD coating.

(W.-Nr. 1.2379/AISI D2)
A standard tool steel grade commonly used for low to medium strength sheet materials.

Uddeholm Sleipner®
A multi purpose tool steel with a broad property profile. A common upgrade from the traditional AISI D2/W.-Nr. 1.2379. It is characterized by improved chipping compressive strength and dimensional stability.

Uddeholm Calmax®
Very good chipping resistance makes Uddeholm Calmax suitable for short to medium length production runs where chipping or breakage are the predominant failure mechanisms.

Uddeholm Caldie®
Has a very good combination of cracking resistance and compressive strength. This means that it is very useful for blanking and forming advanced high strength steel sheet. Uddeholm Caldie is also a perfect substrate for all kinds of surface coatings.

Uddeholm Vanadis® 4 Extra SuperClean
Has the best combination of wear and chipping resistance of all the steels in the programme. It plays an important role as a problem solver in blanking applications.

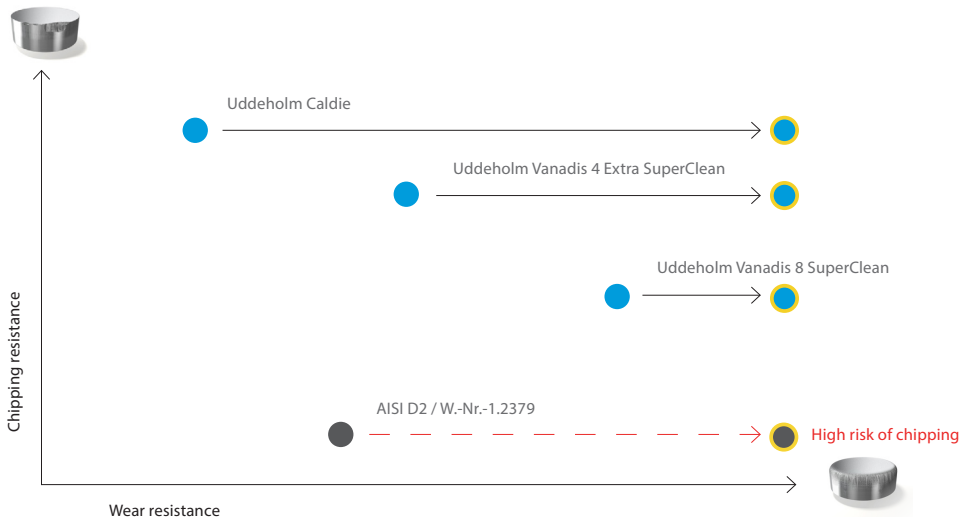
Uddeholm Vanadis® 8 SuperClean
Combines one of the highest wear resistances on the market with good chipping resistance and compressive strength.

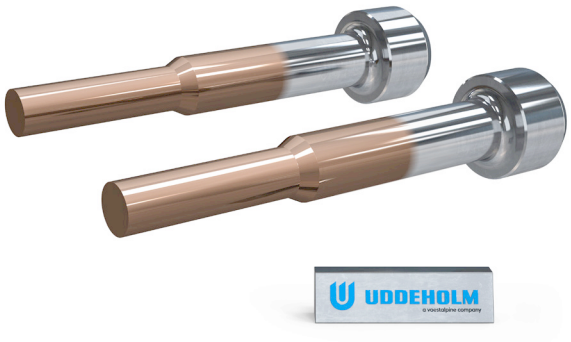
Uddeholm Vancron® SuperClean
A real innovation in the world of tooling with the unique combination of adhesive and abrasive wear resistance with low friction propertes. Can also be used without a coating for many advanced high strength steel applications.

UDDEHOLM STEEL WITH PVD COATING

The perfect match

From a tooling perspective AHSS has raised the demand on the tool material. The need for a combination of high chipping resistance and wear resistance is crucial. This fact will exclude many of the traditional tool steels on the market and open up for Uddeholm high performance tool steels. In fact the combination of Uddeholm high performance tool steels with a PVD coating is an excellent solution for AHSS.





Since 1668 we have been providing a wide range of innovative cutting-edge solutions for our customers in demanding segments. Our dedicated employees work in almost ninety countries and together we deliver improved competitiveness to clients worldwide. Welcome to Uddeholm.