



# Uddeholm Vanadis® 8 XL

## A New Standard in Extreme Abrasive Wear Resistance

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Uddeholm Vanadis 8 XL is a game changer for tooling in high-wear environments. It delivers pure abrasive wear resistance, outperforming established cold work steels (and even some high-speed steels) while holding its own against cemented carbides. Uddeholm Vanadis 8 XL represents a significant advancement in tool steel technology. By harnessing a novel PM manufacturing process and a bold design philosophy (utilizing coarse carbides for maximum wear resistance), this steel offers a new global standard in resisting abrasive wear. It effectively fills the gap between traditional high-performance tool steels and cemented carbides. At the same time, it provides the practical benefits of a tool steel – toughness, dimensional stability, reparability, cost-effectiveness – resulting in an attractive total cost of ownership.

### CHALLENGES IN BLANKING AHSS AND ELECTRICAL STEEL SHEETS

Advanced materials like AHSS (Advanced High-Strength Steel) and electrical steel sheets impose extreme demands on tooling. Their high strength and hardness mean that stamping or blanking them subject tools to intense abrasive action and

risk of chipping or galling. In AHSS blanking, for example, the sheet can act like sandpaper on the tool, rapidly scratching and wearing down the corners and the edge of the tool steel.

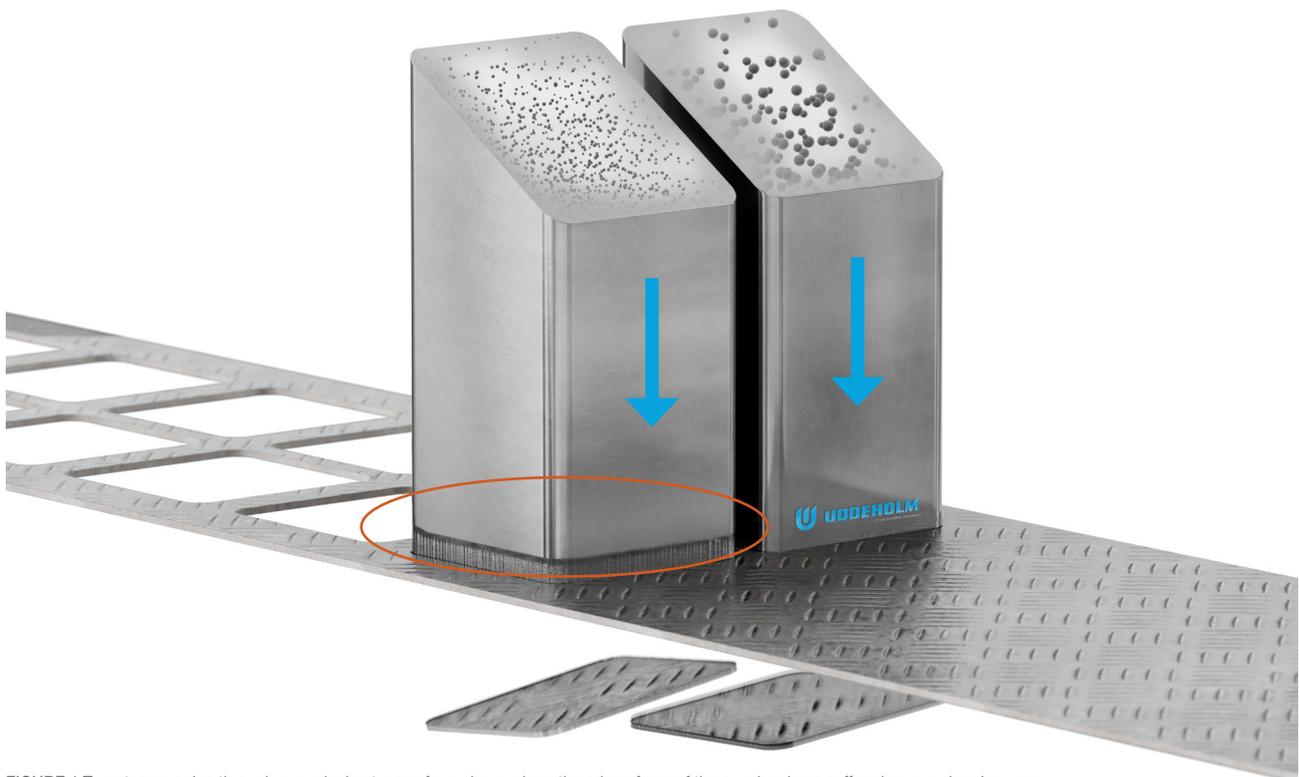


FIGURE 1 Two stamps going through a rough sheet, seen from above where the edge of one of the punches have suffered severe abrasive wear.

Electrical steel laminations, often coated or high in abrasive alloying (like silicon oxides), similarly cause accelerated die wear. These conditions shorten tool life, leading to frequent re-grinding or replacement of the tool, costly downtime, and higher production costs.

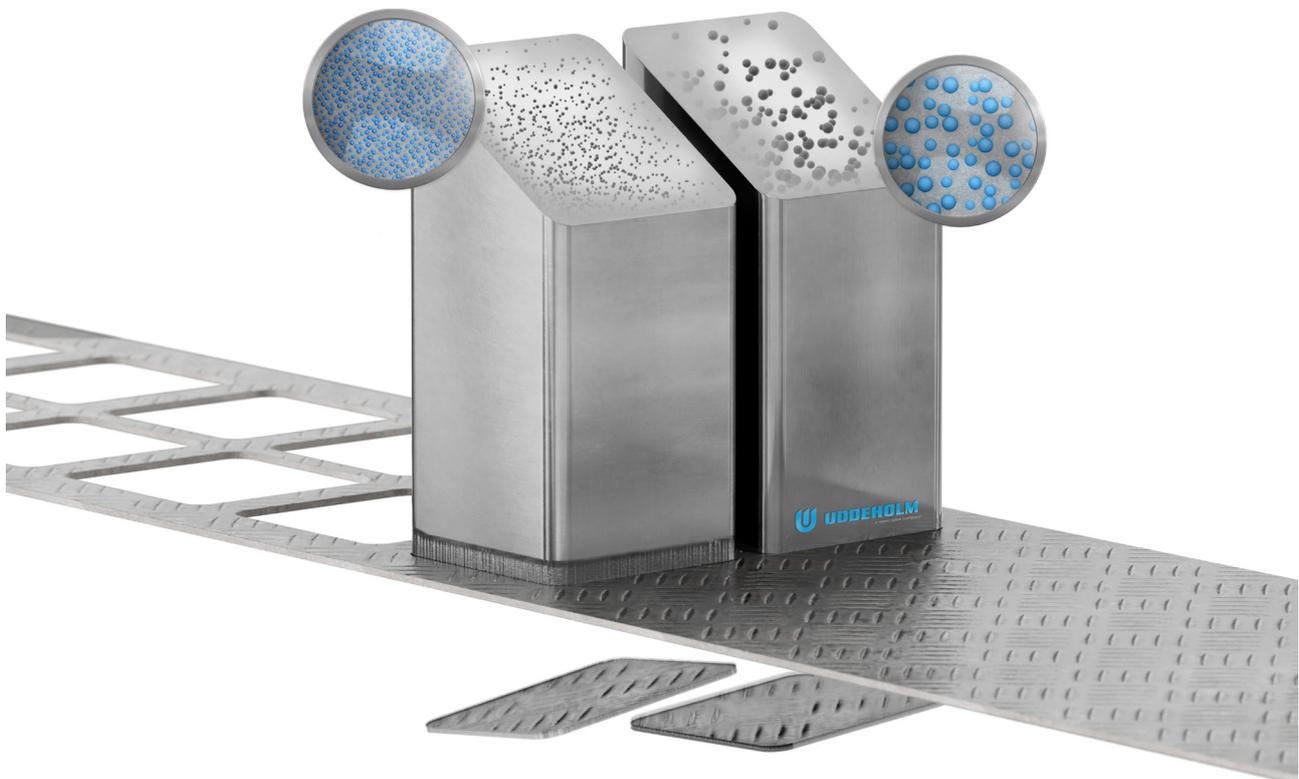
Conventional cold work tool steels (such as standard chromium steels like D2) struggle in these applications. They may attain high hardness but tend to wear out or chip quickly when facing the abrasive, high-force environment of AHSS and electrical sheet stamping. Tool users often resort to expensive solutions like carbide tooling to get adequate life in such cases. Clearly, a new approach in tool steel industry was needed to combine ultra-high wear resistance with sufficient toughness to withstand these demanding conditions.

Uddeholm Vanadis 8 XL was developed in direct response to these challenges. Introduced as an evolution of our cold work PM (powder metallurgy) steel portfolio, Uddeholm Vanadis 8 XL specifically targets applications where abrasive wear is the dominant failure mechanism. These include blanking and punching of AHSS parts, stamping thin but abrasive materials, and blanking electrical steel sheets, where standard tool steels often fail prematurely. By leveraging novel metallurgy, Uddeholm Vanadis 8 XL is engineered to dramatically extend tool life in such environments, thereby improving productivity and reducing downtime.



#### INNOVATING FOR PURE ABRASIVE WEAR: UDDEHOLM VANADIS 8 XL

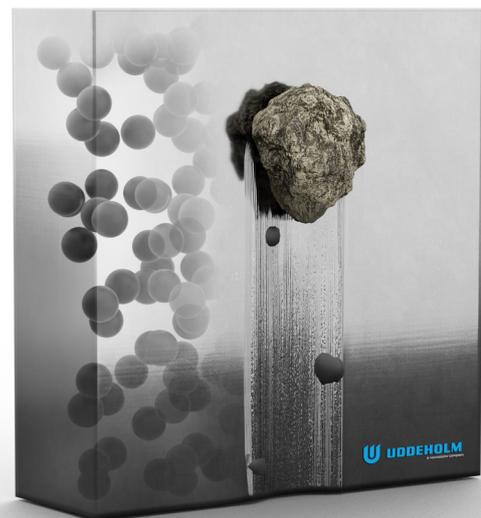
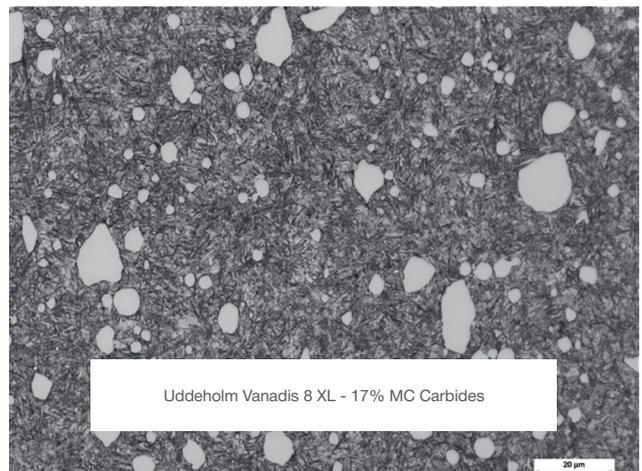
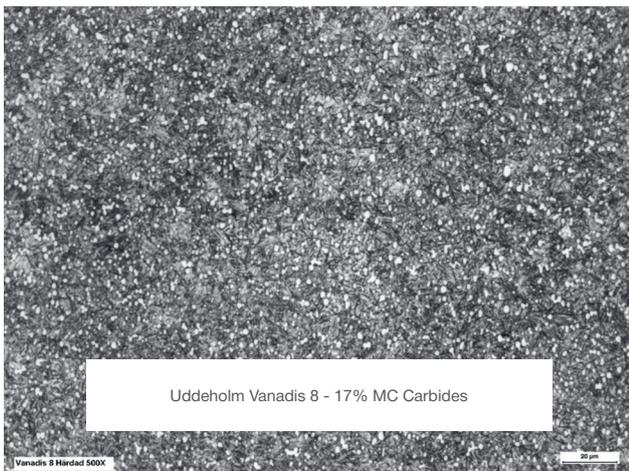
Uddeholm Vanadis 8 XL is a new high-performance cold work tool steel designed to set a global benchmark in abrasive wear resistance. Achieving its extraordinary properties required innovative metallurgy processing. We developed a unique manufacturing method to create a steel with an unprecedented carbide microstructure. The result is a “bigger sister” to the well-known and beloved Uddeholm Vanadis 8. Uddeholm Vanadis 8 XL retains the same chemical base ( $\approx 2.3\%$  C, 8% V, with Cr and Mo alloying) and  $\sim 17\%$  volume fraction of hard carbides in the microstructure, but those carbides are significantly coarser in size. In other words, Uddeholm Vanadis 8 XL contains fewer but larger vanadium-rich carbide particles, distributed evenly throughout a very clean martensitic matrix.



**WHY COARSE CARBIDES?**

In conventional PM steel design, very fine carbides are preferred for a good ductility-to-mixed wear (abrasive and adhesive) balance. Uddeholm Vanadis 8 XL takes a different approach, as it is optimized purely for abrasive wear. The enlarged carbide particles act as extremely hard "micro-reinforcements" that protrude from and protect the steel matrix under abrasive contact. Vanadium carbides are incredibly hard ( $\approx$ HV 2800), and in Uddeholm Vanadis 8 XL these

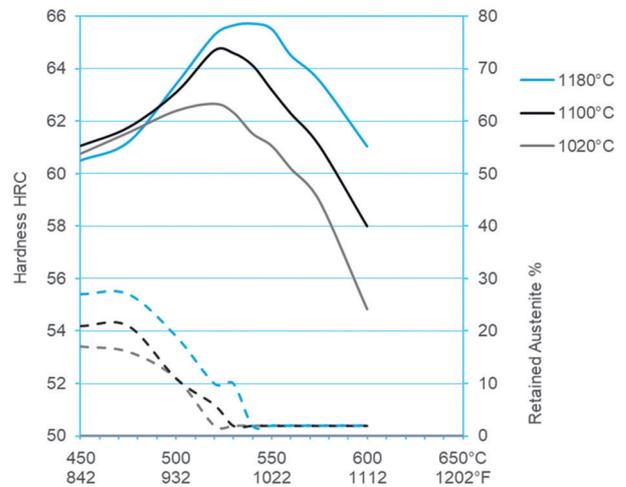
carbide "islands" are large enough to blunt or block the abrasive particles wearing against the tool. Notably, Uddeholm Vanadis 8 XL still has the same total carbide content as Uddeholm Vanadis 8 but arranged in a coarse topology to maximize longevity in abrasive environments. This new grade offers exceptional wear resistance in extreme conditions and is closing the gap between steel and cemented carbides.



Despite its focus on wear, Uddeholm Vanadis 8 XL maintains a robust overall mechanical profile. It can be hardened up to ~64–65 HRC, like Uddeholm Vanadis 8, and exhibits very high compressive strength (on the order of 2700–2800 MPa yield strength at 64 HRC) to resist deformation under load. In fact, tests show Uddeholm Vanadis 8 XL has at least equal compressive strength to Uddeholm Vanadis 8 at a given hardness.

Uddeholm Vanadis 8XL offers excellent through-hardening performance. Even large or intricate tools can be fully hardened, thanks to its generous hardenability and recommended austenitizing range of 1020–1180 °C. This is a key advantage over standard high-speed steels.

For optimal results, a high tempering temperature ( $\geq 550^{\circ}\text{C}$ ) is advised to attain maximum dimensional stability and compressive strength. This stability is crucial for precision blanking operations in electrical sheets and AHSS, where maintaining clearance and alignment can make the difference between success or galling and fractures.



### A cleaner choice – for people and planet

Every tool you replace costs time, material and energy. Uddeholm Vanadis 8 XL changes that. Its long tool life means fewer tool changes, less scrap and lower consumption of resources, a quiet but powerful way to reduce your environmental footprint.

Just as important: Uddeholm Vanadis 8 XL is 100% cobalt-free. Unlike high-speed steels or cemented carbides that depend on cobalt binders, this alloy avoids a hazardous and critical raw material – good for both health and supply chains. And since there is no cobalt, there is no need for special filtration when machining.

Small changes in material choice can lead to lasting impact. Uddeholm Vanadis 8 XL supports our vision: “Shaping the world – manufacturing solutions for generations to come.”

## APPLICATION AREAS

The typical applications for Uddeholm Vanadis 8 XL are those where abrasive wear currently forces users into either recurring tool maintenance or the use of ultra-hard (but expensive/brittle) materials. It is targeted as a sustainable and cost-effective alternative to cemented carbides in many such high-wear applications. Typical examples include:

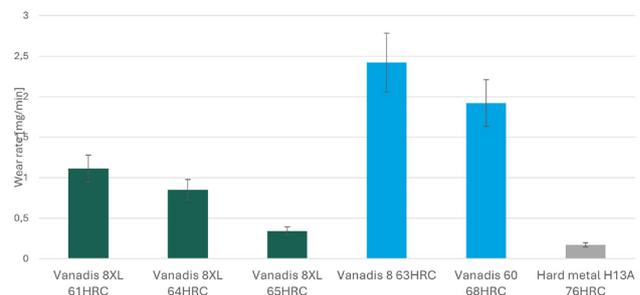
- Blanking and punching thinner abrasive sheets, including AHSS automotive parts and high-strength electrical steels
- Forming tools for abrasive materials, e.g. punching of pre-hardened or high-Si alloy sheets
- Guide rolls, calibration rolls, cutting and anvil rolls that see continuous abrasive contact (such as in rolling of reinforced mesh or wire)
- Recycling knives and granulator blades that cut hard, dirty scrap or composites
- Powder compaction tools (dies/punches compacting abrasive powder materials)
- Extruder screws and barrels handling abrasive mixtures (plastics with fillers, powder paints, etc.)



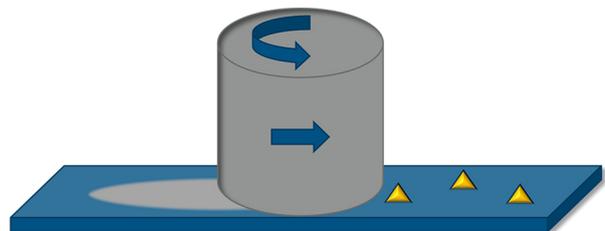
In general, any tool currently using cemented carbide inserts or wear parts due to abrasive wear could be a candidate for Uddeholm Vanadis 8 XL, especially if cost or toughness considerations make carbide less than ideal. Uddeholm Vanadis 8 XL will maximize production uptime in a profitable and sustainable way by significantly extending intervals between tool maintenance.

## TRIBOLOGICAL PERFORMANCE AND KEY PROPERTIES

Abrasive wear test results comparing Vanadis 8 XL with other tool materials (lower bars indicate less wear). In a pin-on-disc tribology test with  $\text{Al}_2\text{O}_3$  abrasive, Uddeholm Vanadis 8 XL shows dramatically lower wear rate than conventional PM steels and even surpasses the high-speed steel Uddeholm Vanadis 60, approaching cemented carbide performance.



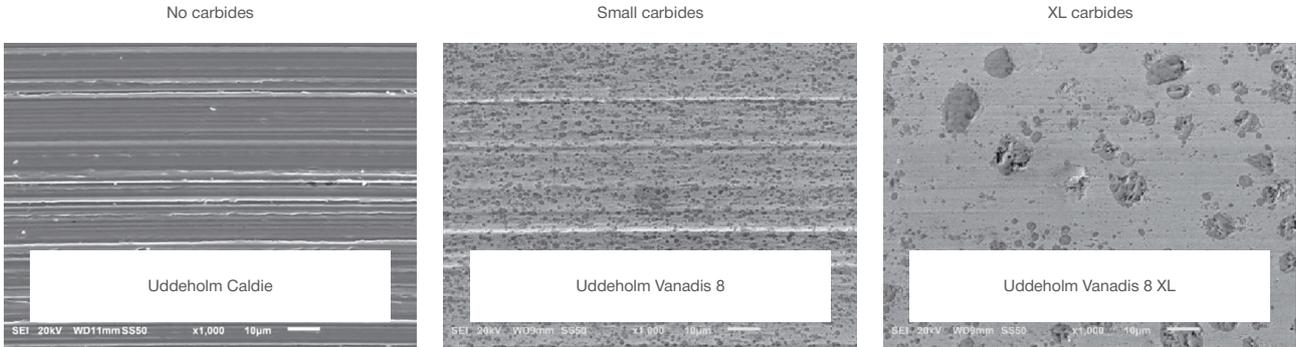
The defining feature of Uddeholm Vanadis 8 XL is its superior abrasive wear resistance. Controlled laboratory tribology tests substantiate the steel's performance gains. In one test, a cylinder of each tool material was rotated under load against a  $63 \mu\text{m}$  alumina ( $\text{Al}_2\text{O}_3$ ) abrasive, and the mass loss was measured.



Under identical conditions (~61 HRC hardness, 100 N load), a conventional 12% Cr tool steel (AISI D2) lost about 22.5 mg of material in the short test, whereas Uddeholm Vanadis® 8 lost only ~2.1 mg, Uddeholm Vanadis® 60 lost ~1.9 mg, and Uddeholm Vanadis 8 XL lost a mere ~1.0 mg.

The coarser carbides in Uddeholm Vanadis 8 XL act as stronger barriers against micro-cutting. SEM analysis after tribology testing clearly shows that larger carbides result in less abrasive wear.

LARGER CARBIDES → LESS ABRASIVE WEAR



These improvements can translate directly into longer intervals between tool repairs or change and significantly increase number of parts produced per tool in production settings.

Crucially, Uddeholm Vanadis 8 XL achieves this wear resistance without sacrificing hardness or strength. Depending on heat treatment, Uddeholm Vanadis 8 XL can reach up to ~65 HRC. At peak hardness (~64–65 HRC), its abrasive wear rate in testing was closing in on cemented carbide grade (WC-Co hardmetal ~76 HRC).

In fact, Uddeholm Vanadis 8 XL offers higher wear resistance than the high-speed PM steel grade Uddeholm Vanadis 60 (which contains 10% vanadium + cobalt). This is a remarkable achievement. Traditionally, only cemented carbides could provide such wear performance.

One consideration with Uddeholm Vanadis 8 XL's very high carbide content is that its machinability is somewhat reduced compared to lower-alloy grades. Large vanadium carbides are challenging for cutting tools during milling, drilling, or grinding of the tool before hardening. Uddeholm provides tailored machining guidelines, and with appropriate tooling (carbide or CBN cutters) and parameters, Uddeholm Vanadis 8 XL can be machined successfully. This is a common trade-off: the same attributes that give extraordinary lifetime against abrasive wear can make a tool steel harder to work with in the annealed condition. Many users find this an acceptable compromise given the overall cost savings.

**REAL-WORLD SUCCESS STORIES**

New tool materials prove their worth not just in lab tests, but in real production environments. Uddeholm Vanadis 8 XL has been trialed by customers in various high-wear applications, and the results have been impressive. Below are a real-world case demonstrating its performance versus traditional solutions.

Guide Roll for Reinforcing Mesh: In a steel wire mesh production line, guide rolls continuously shape or direct abrasive iron wires. The customer's original rolls, made of Uddeholm Sverker 3, (a traditional high-carbon tool steel) were wearing out and had to be replaced after about 6 months of service. A switch was made to Uddeholm Vanadis 8 XL (at ~62–64 HRC).



After 6 months of use the Uddeholm Vanadis 8 XL roll still looked new!

The difference was dramatic – after 6 months of use, the Uddeholm Vanadis 8 XL roll “still looked new” with no notable wear, whereas the previous Uddeholm Sverker 3 roll was completely worn by that point. In fact, the Uddeholm Vanadis 8 XL roll was still in operation beyond 6 months with no signs of needing replacement. The customer was extremely pleased with the outcome.

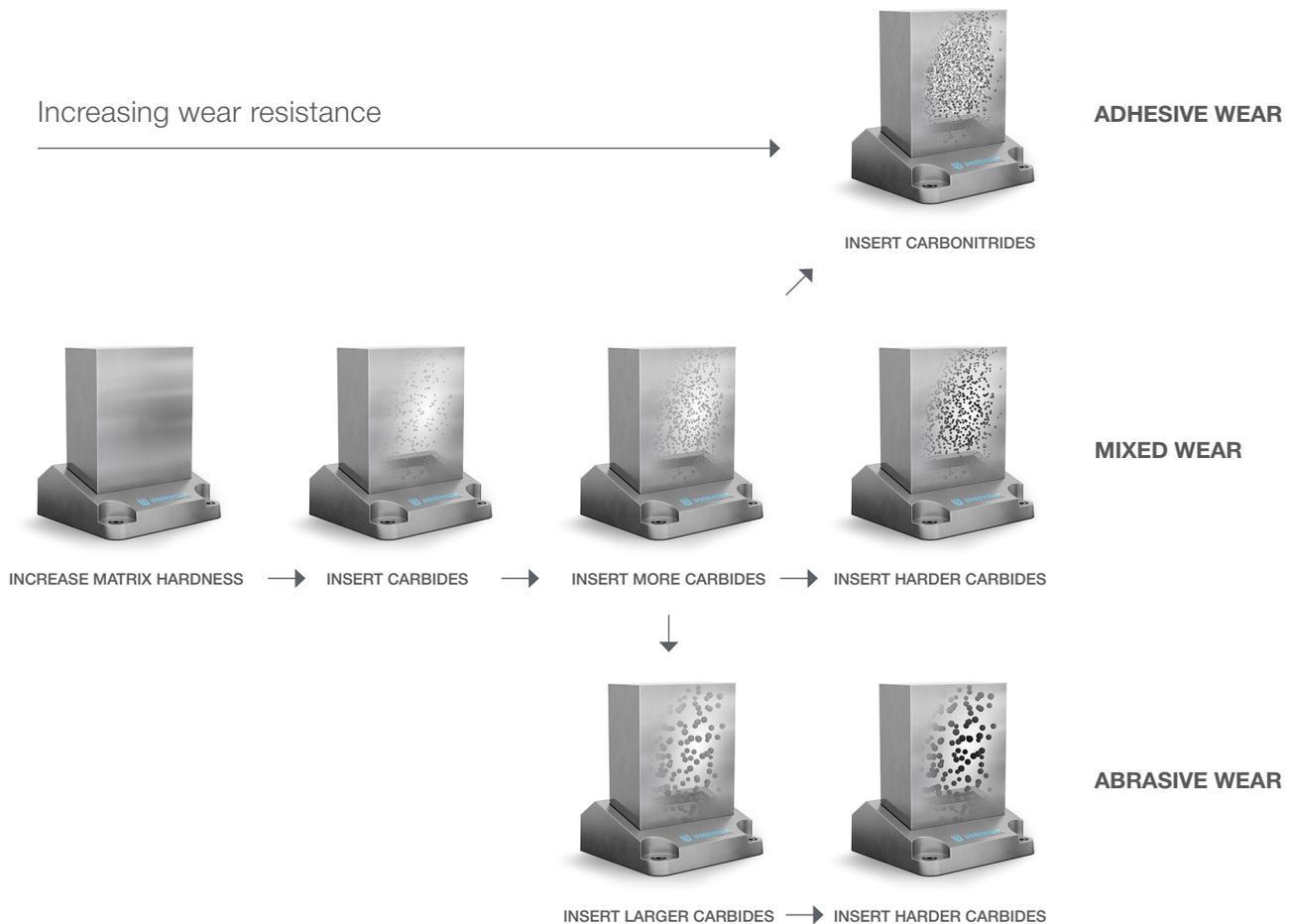
This case highlights how Uddeholm Vanadis 8 XL can extend tool life from months to years in applications that were previously limited by abrasive wear. The reduced downtime and replacement costs directly translate into higher productivity and lower cost per part for the user.



	Uddeholm Sverker 3	Uddeholm Vanadis 8 XL
Hardness (HRC)	62-64	62-64
Wear	Wear	Wear
Tool life	6 months	30 months

PERFORMANCE COMPARISON WITH OTHER TOOL MATERIALS

Uddeholm Grade	When to use	Advantages	Limitations
Vanadis 8 XL	Pure abrasive wear is the primary failure mode (e.g. e-sheet, AHSS, Components). Alternative to Cemented Carbides.	<ul style="list-style-type: none"> <li>• Extreme abrasive wear resistance</li> <li>• Tougher than carbide</li> <li>• No cobalt</li> </ul>	<ul style="list-style-type: none"> <li>• Lower ductility</li> <li>• Not ideal for mixed wear or galling</li> </ul>
Vanadis 4 Extra	Mixed wear with risk of chipping or cracking (e.g. forming AHSS)	<ul style="list-style-type: none"> <li>• Excellent toughness</li> <li>• Good all-round wear resistance</li> </ul>	<ul style="list-style-type: none"> <li>• Wears faster in purely abrasive applications</li> </ul>
Vanadis 8	Long runs with mixed adhesive / abrasive wear (e.g. progressive dies)	<ul style="list-style-type: none"> <li>• Very fine carbide structure</li> <li>• Balanced ductility and mixed wear</li> <li>• High edge retention</li> </ul>	<ul style="list-style-type: none"> <li>• Less abrasive wear life if the wear is purely abrasive</li> </ul>
Vanadis 60	Abrasive wear + some heat exposure (e.g. hot stamping, coated sheet)	<ul style="list-style-type: none"> <li>• Very high hardness (up to 68 HRC)</li> <li>• Red hardness</li> <li>• Long wear life</li> </ul>	<ul style="list-style-type: none"> <li>• Contains cobalt</li> <li>• Lower toughness</li> <li>• Costlier</li> </ul>
Vancron	Galling and friction dominate (e.g. forming galvanized / stainless steel)	<ul style="list-style-type: none"> <li>• Excellent anti-galling</li> <li>• Low friction</li> <li>• High edge retention</li> </ul>	<ul style="list-style-type: none"> <li>• Lower abrasive wear resistance</li> <li>• Softer than other PM steels</li> </ul>
Cemented Carbide	Maximum wear life with minimal impact (e.g. high-volume blanking, no shock load)	<ul style="list-style-type: none"> <li>• Highest hardness</li> <li>• Outstanding wear life</li> </ul>	<ul style="list-style-type: none"> <li>• Relies on conflict minerals</li> <li>• Hazardous during machining</li> <li>• Expensive</li> <li>• Difficult to machine or repair</li> </ul>



Uddeholm Vanadis 8 XL often outlasts the competition by a wide margin in high-wear environments, whether the comparison is against conventional tool steel or earlier PM grades. In each case, the upgrade to Uddeholm Vanadis 8 XL yielded longer tool life and reduced maintenance, directly supporting higher productivity. Users reported not only lower wear, but also that the tools maintained their geometry much longer, leading to better consistency in the manufactured products.

#### **CONCLUSION: A COST-EFFICIENT, SUSTAINABLE ALTERNATIVE TO HARD METALS**

Uddeholm Vanadis 8 XL represents a significant advancement in tool steel technology. By harnessing a novel PM manufacturing process and a bold design philosophy (using coarse carbides for maximum wear resistance), this steel offers a “new global standard” in resisting abrasive wear. It effectively fills the gap between traditional high-performance tool steels and cemented carbides.

In summary, our new Uddeholm PM grade is a game-changer for tooling in high-wear environments. It delivers pure abrasive wear resistance that outperforms established cold work steels (and even some high-speed steels), while holding its own against cemented carbides.

At the same time, it provides the practical benefits of a tool steel – toughness, dimensional stability, reparability, and cost-effectiveness – resulting in an attractive total cost of ownership. The development of Uddeholm Vanadis 8 XL showcases our commitment to innovation in tool materials: as manufacturing materials evolve (becoming stronger, harder, more abrasive), tooling materials like Uddeholm Vanadis 8 XL evolve to meet those demands.

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Uddeholm Vanadis 8 XL is not replacing anyone – she is just the newest sister in the Vanadis family. Like any youngest sibling, she might claim she is the best at everything. But the truth is, her big sisters Uddeholm Vanadis 8 and Uddeholm Vanadis 4 Extra are still leading the way when it comes to mixed wear and chipping resistance. Everyone brings their own strengths – and that is what makes the Uddeholm family unbeatable.