Uddeholm

Vanadis® 8 XL

UDDEHOLM
a voestalpine company

This information is based on our present state of knowledge and is intended to provide general notes on our products and their uses. It should not therefore be construed as a warranty of specific properties of the products described or a warranty for fitness for a particular purpose.

Classified according to EU Directive 1999/45/EC

For further information see our “Material Safety Data Sheets”.

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CRITICAL TOOL STEEL PROPERTIES

For good tool performance

Uddeholm's new steel for applications that require extreme wear resistance in abrasion. The coarser carbides in the material structure will give you better performance and longevity in the tools.

Carbides are very hard particles in the steel that give it extra wear resistance and durability. Think of them as small reinforcements that protect the steel from wear. In Uddeholm Vanadis 8 XL, the carbides are coarser, which increases the life of the tools and reduces the need for maintenance – and with high abrasion.

Uddeholm Vanadis 8 XL is not only strong and durable, but also a well-thought-out, sustainable choice. The longer tool life means fewer tool changes and less maintenance, saving time, costs, resources and is also cobalt-free, supporting our customers' goals to reduce their environmental impact. By offering Uddeholm Vanadis 8 XL, we are taking concrete steps for a sustainable future.

APPLICATION

Uddeholm Vanadis 8 XL is specifically developed for extremely demanding tool applications where abrasive wear is the primary challenge. Its exceptional wear resistance makes it an ideal substitute for hard metals, especially in applications involving highly abrasive working materials. Typical applications include:

- Powder compaction
- Recycling knives
- Calibration rolls
- Cutting rolls
- Anvils roll
- Guide rolls
- Forming and punching of thinner abrasive sheets
- Blanking of electrical sheets
- Extruder screws and barrels

General applications where cemented carbide is typically used.

GENERAL

Uddeholm Vanadis 8 XL is a chromium-molybdenum-vanadium alloyed steel characterized by:

- Extremely high wear resistance, ideal for highly abrasive environments
- High hardness and compressive strength
- Excellent through-hardenability
- Outstanding dimensional stability
- High temper-back resistance

With its superior wear resistance, Uddeholm Vanadis 8 XL offers a sustainable and cost-effective alternative to cemented carbide in the most demanding tool applications.

Typical Analysis %	C 2.3	Si 0.4	Mn 0.4	Cr 4.8	Mo 3.6	V 8.0
Delivery condition	Annealed					
Colour code	Blue/violet					

PROPERTIES

Physical data

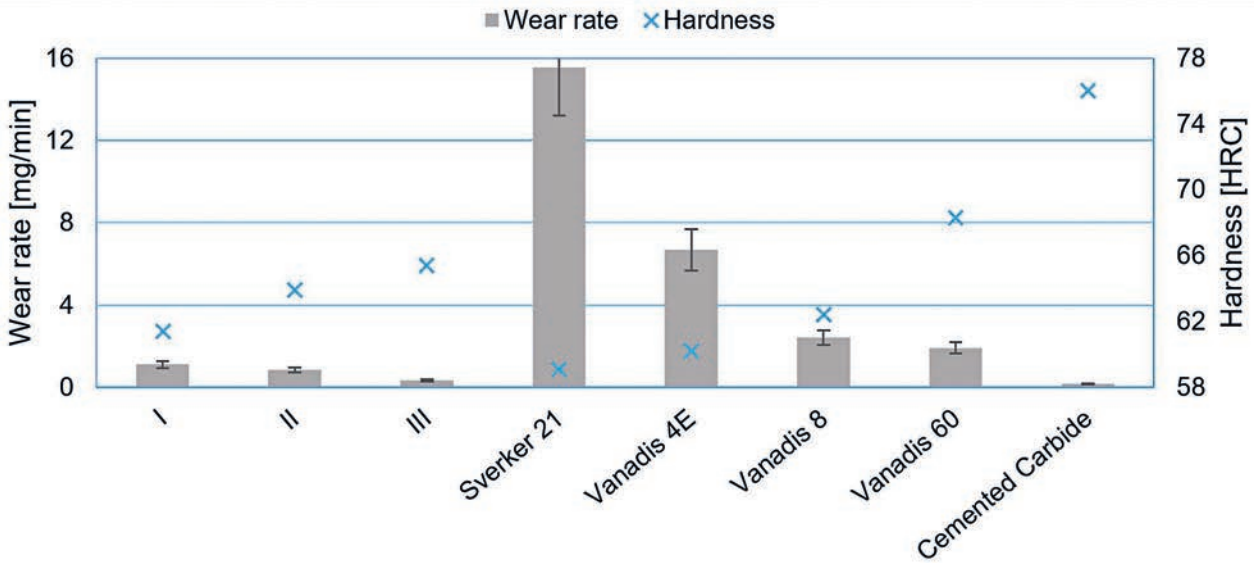
Hardened and tempered to 63.2 HRC.

Temperature	20°C (68°F)	200°C (390°F)	400°C (750°F)
Density g/cm3 lbs/in3	7 490 0.2706	–	–
Modulus of elasticity N/mm² psi	220 000 32.0×10⁶	214 000 31.0×10⁶	202 000 29.3×10⁶
Coefficient of thermal expansion °C from 20 °F from 68	–	11.2×10⁻⁶ 6.2×10⁻⁶	11.9×10⁻⁶ 6.6×10⁻⁶
Thermal conductivity W/m°C Btu in/(ft² h °F)	–	25.6 177	26.8 186
Specific heat J/kg°C Btu/lb°F	510 0.12	–	–

Wear properties

Relative wear properties of Vanadis 8 XL at three different heat treatment conditions (I, II and III), +Sverker 21, Vanadis 4 Extra, Vanadis 8 and Vanadis 60 and cemented carbide is shown in the following graph.

The method used is Pin on Disc in which a cylinder of tool steel rotates and slides against a ceramic stone with 400 mesh (63.5 µm) Al_2O_3 particles. Load: 100 N, Rotation speed: 300 rpm, Feed: 2 mm/s, Time: 70 s. Weight of the cylinder is measured before and after the test.



Applied heat treatments:

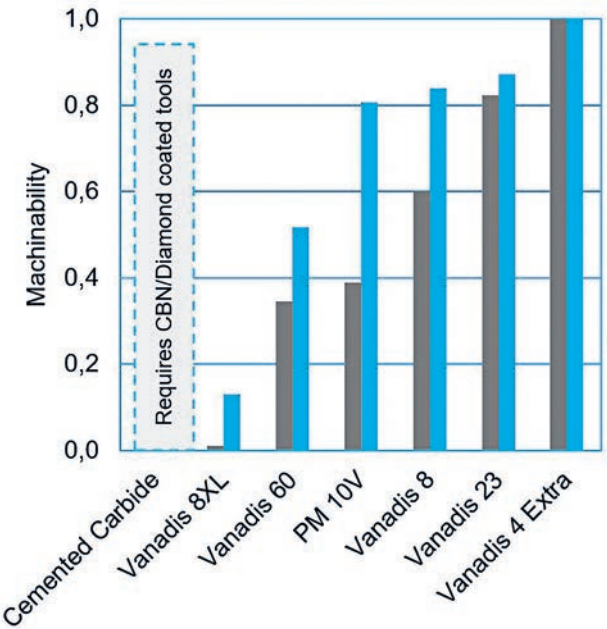
(I) - Austenitizing temperature 1020°C. Holding time 30 minutes. T8/5=300s Tempering at 550 °C for one hour repeated three times.

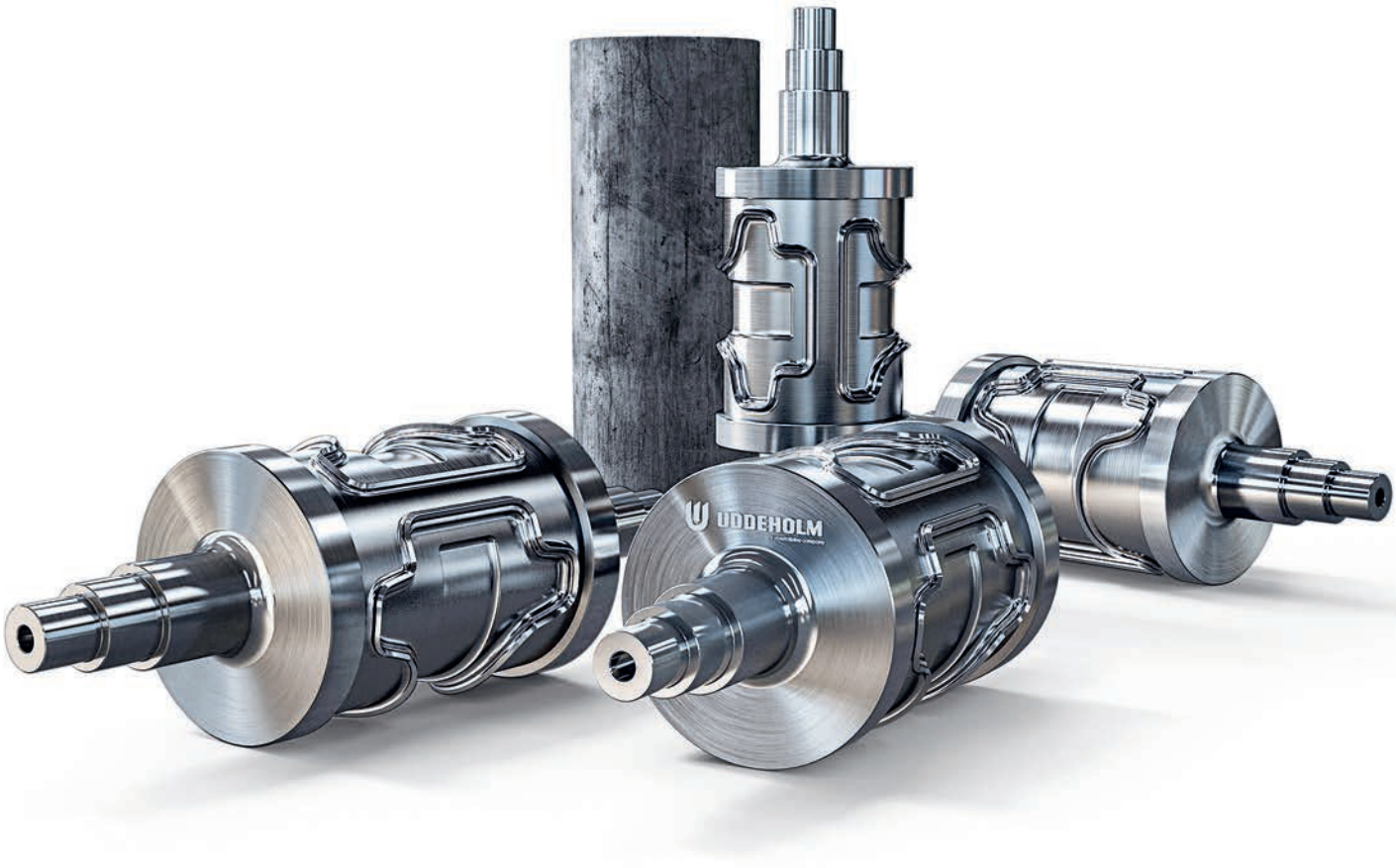
(II) - Austenitizing temperature 1100°C. Holding time 30 minutes. T8/5=300s Tempering at 550 °C for one hour repeated three times.

(III) - Austenitizing temperature 1180°C. Holding time 30 minutes. T8/5=300s Tempering at 525 °C for one hour repeated three times.

MACHINABILITY

Relative machinability for Uddeholm PM Super-Clean steels Vanadis 60, Vanadis 8, Vanadis 23 and Vanadis 4 Extra compared with PM10V, a 10% Vanadium steel from another producer and cemented carbide.





HEAT TREATMENT

Soft annealing

Protect the steel and heat through to 900°C (1650°F). Cool in the furnace at 10°C (20°F) per hour to 650°C (1200°F), then freely in air.

Stress relieving

After rough machining the tool should be heated through to 650°C (1200°F), holding time 2 hours. Cool slowly to 500°C (930°F), then freely in air.

Hardening

Pre-heating temperature: First pre-heating at 600–650°C (1110–1200°F) and second at 850–900°C (1560–1650°F)

Austenitizing temperature: 1020–1180°C (1870–2160°F) Holding time: 30 minutes for hardening temperatures up to 1100°C (2010°F), 15 minutes for temperatures higher than 1100°C (2010°F).

Note: Holding time = time at hardening temperature after the tool is fully heated through. A holding time of less than recommended time will result in loss of hardness.

The tool should be protected against decarburization and oxidation during hardening.

Further information can be found in the Uddeholm brochure “Heat treatment of tool steels”.

Quenching media

- Vacuum (high speed gas at sufficient overpressure minimum 2 bar)
- Martempering bath or fluidized bed at 200–550°C (390–1020°F)
- Forced air/gas

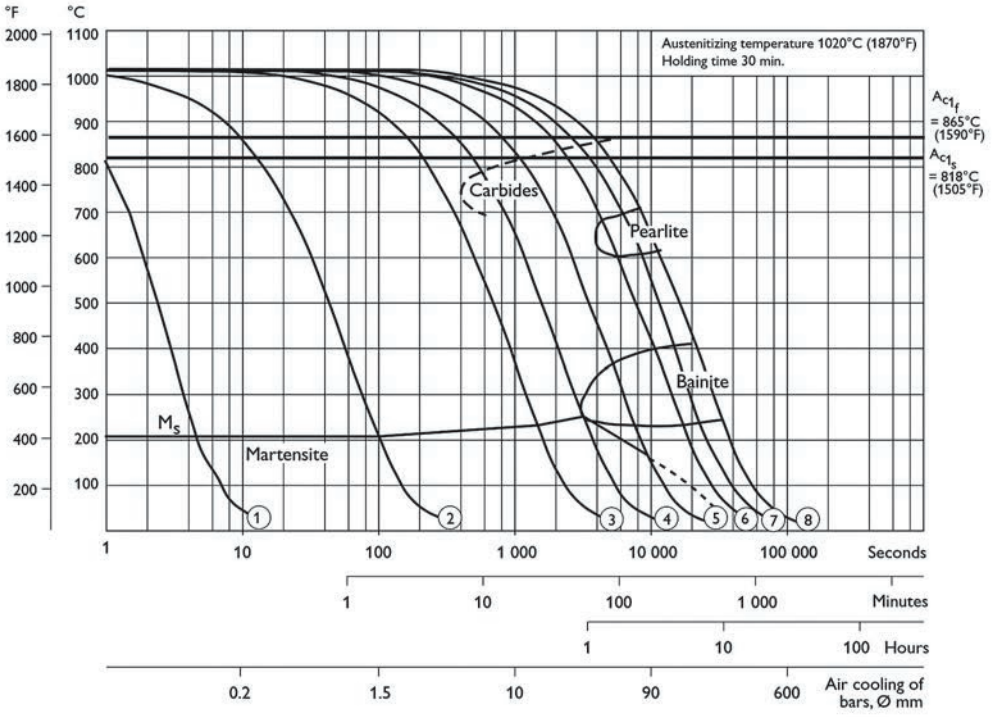
Note: Temper the tool as soon as its temperature reaches 50–70°C (120–160°F). In order to obtain the optimum properties for the tool, the cooling rate should be as fast as possible with regards to acceptable distortion.

A slow quench rate will result in loss of hardness compared with the given tempering curves.

Martempering should be followed by forced air cooling if wall thickness is exceeding 50 mm (2”).

CCT-GRAPHS

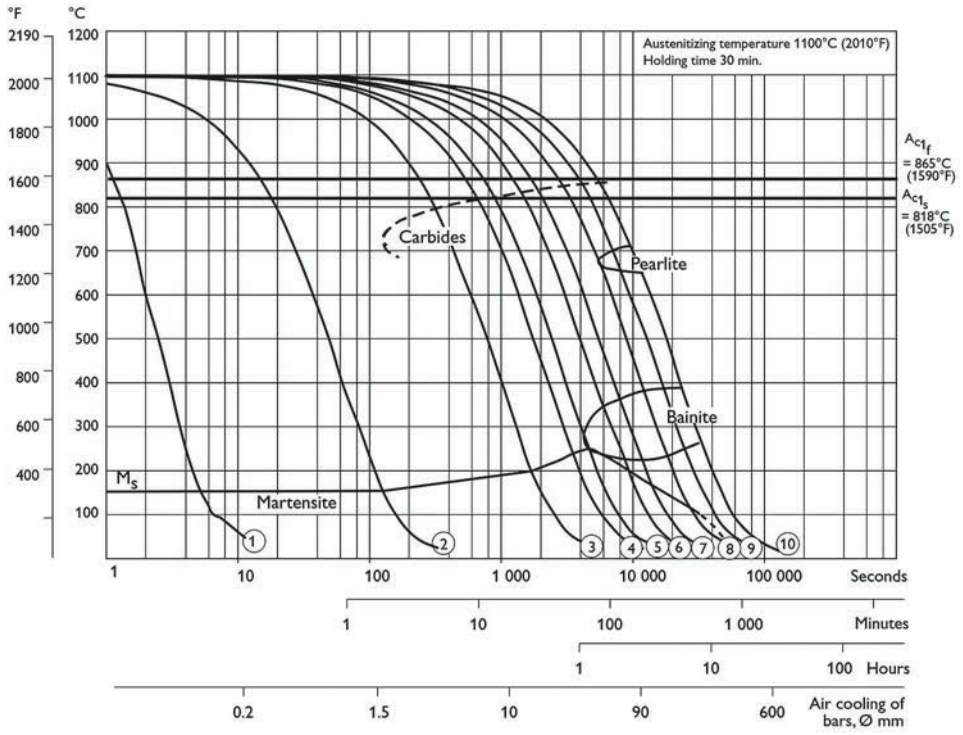
Austenitizing temperature 1020°C (1870°F). Holding time 30 minutes.



Cooling Curve No.	Hardness HV 10	T800-500 (sec)
1	853	1
2	822	28
3	761	450
4	793	1030
5	721	2325
6	533	5215
7	518	7320
8	469	10400

CCT-GRAPHS

Austenitizing temperature 1100°C (2012°F). Holding time 30 minutes.



Cooling Curve No.	Hardness HV 10	T800-500 (sec)
1	748	1
2	803	28
3	873	450
4	763	1030
5	805	1390
6	782	2325
7	718	3205
8	569	5215
9	493	7320
10	493	10400

Tempering

Choose the tempering temperature according to the hardness required by reference to the tempering graph. Temper at least twice with intermediate cooling to room temperature.

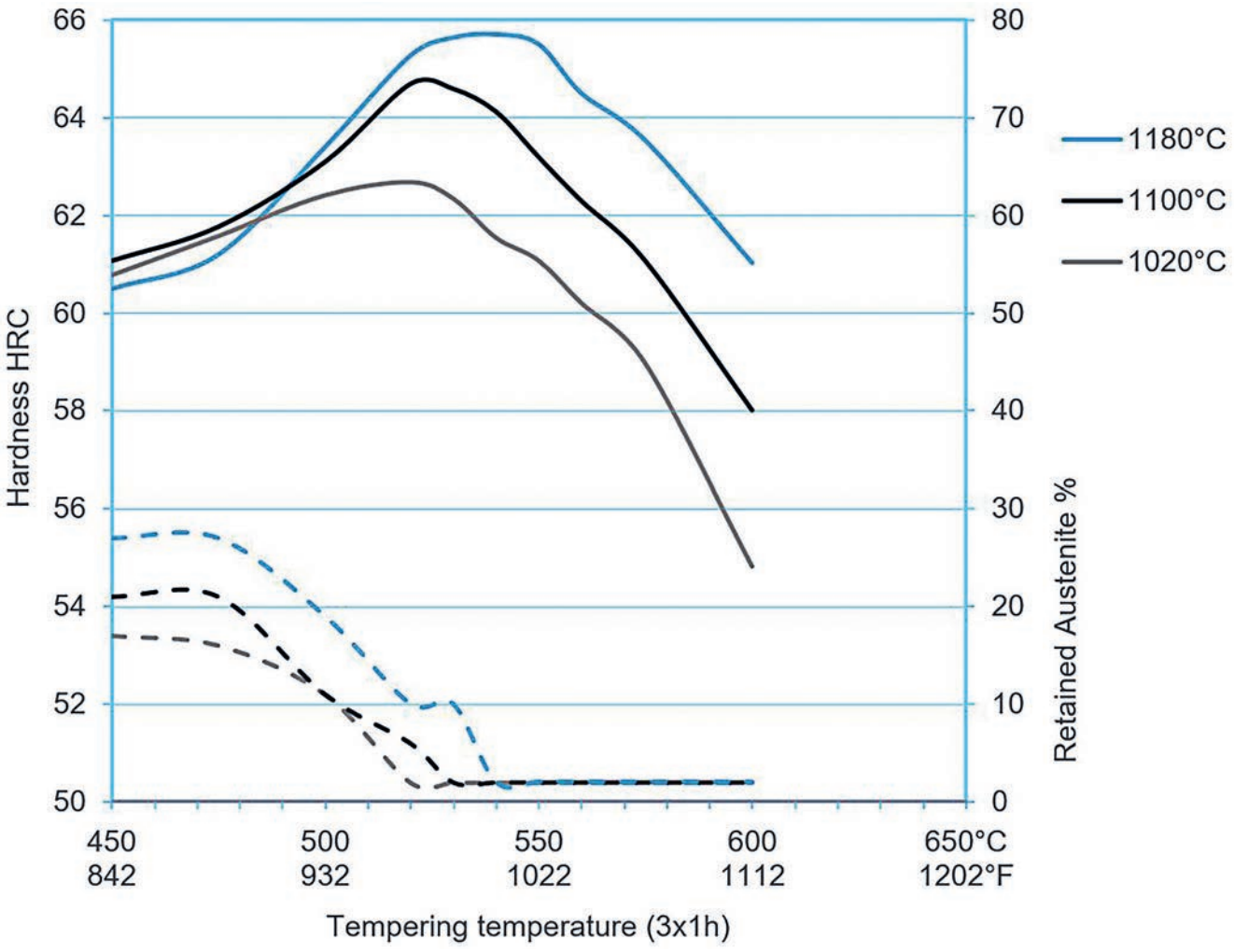
For highest dimensional stability and ductility, a minimum temperature of 540°C (1000°F), preferably 550°C (1022°F), and three tempers is strongly recommended.

Tempering at a lower temperature than 540°C (1000°F) may increase the hardness and compressive strength to some extent but also impair cracking resistance and dimensional stability. However, if lowering the tempering temperature, do not temper below 520°C (970°F).

Tempering graph

Vanadis 8 XL (T8/5=300s). The tempering curves are obtained after heat treatment of samples with a size of 15 x 15 x 40 mm, cooling in forced air. Lower hardness can be expected after heat treatment of tools and dies due to factors like actual tool size and heat treatment parameters.

When tempering twice the minimum holding time at temperature is 2 hours. When tempering three times the minimum holding time is 1 hour.



CUTTING DATA RECOMMENDATIONS

Vanadis 8 XL is designed for exceptional wear resistance, thanks to its larger MC carbide structure. However, this also makes it challenging to machine. The cutting data below are to be considered as guiding values which must be adapted to existing local conditions. Further information can be found in the Uddeholm publication “Cutting data recommendations”.

Turning

Cutting data parameter	Turning with carbide	
	Rough turning	Fine turning
Cutting speed (v_c) m/min f.p.m.	70-100 230-330	100-120 330-395
Feed (f) mm/rev i.p.r.	0.2-0.4 0.008-0.016	0.1-0.2 0.004-0.008
Depth of cut (a_p) mm inch	2-4 0.08-0.16	0.5-2 0.02-0.08
Carbide designation ISO	K05-10, P05 Coated carbide*	K05, P05 Coated carbide*

** Use a high wear resistant CVD coated carbide grade, e.g. Coromant 4405.*

Drilling

High speed steel twist drill

Drill diameter		Cutting speed (vc)		Feed (f)	
mm	inch	m/min	f.p.m.	mm/rev	i.p.r.
-5	-3/16	6-8*	20-26*	-0.15	-0.006
5-10	3/16-3/8	6-8*	20-26*	0.15-0.20	0.006-0.008
10-15	3/8-5/8	6-8*	20-26*	0.20-0.25	0.008-0.010
15-20	5/8-3/4	6-8*	20-26*	0.25-0.35	0.008-0.010

** Use coated HSS drill*

Carbide drill

Cutting data parameter	Type of drill		
	Indexable insert	Solid Carbide	Carbide tip[1)]
Cutting speed (v_c) m/min f.p.m.	70-100 230-325	40-60 130-200	20-30 65-100
Feed (f) mm/rev i.p.r.	0.05-0.15[2)] 0.002-0.006[2)]	0.08-0.20[3)] 0.003-0.008[3)]	0.15-025[4)] 0.006-0.010[4)]

1) Drill with replaceable or brazed carbide tip
2) Feed rate for drill diameter 20–40 mm (0.8”–1.6”)
3) Feed rate for drill diameter 5–20 mm (0.2”–0.8”)
4) Feed rate for drill diameter 10–20 mm (0.4”–0.8”)

Milling

Face and square shoulder milling

Cutting data parameter	Milling with carbid	
	Rough milling	Fine milling
Cutting speed (v_c) m/min f.p.m.	40-60 130-200	50-80 160-260
Feed (f) mm/tooth in/tooth	0.20-0.40 0.008-0.016	0.10-0.20 0.004-0.008
Depth of cut (a_p) mm inch	2-4 0.08-0.16	0.5-2 0.02-0.08
Carbide designation ISO	K20, P10-20 Coated carbide*	K15, P10 Coated carbide* or CBN, cermet

** Use a high wear resistant CVD coated carbide grade.*

End milling

Cutting data parameter	Type of milling	
	Solid carbide	Carbide indexable insert
Cutting speed (v_c) m/min f.p.m.	30-50 100-160	40-70 130-230
Feed (f) mm/tooth in/tooth	0.01-0.2[1)] 0.0004-0.008[1)]	0.06-0.2[1)] 0.002-0.008[1)]
Carbide designation ISO	Wear resistant coated carbide	K20-K30 P20-P30 Coated carbide[2)]

1) Depending on radial depth of cut and cutter diameter.
2) Use a high wear resistant CVD coated carbide grade, e.g. Coromant 3330.

Grinding

A general grinding wheel recommendation is given below. More information can be found in the Uddeholm publication “Grinding of tool steel”.

Type of grinding	Annealed condition	Hardened condition
Face grinding straight wheel	A 46 HV	B151 R50 B3* A 46 GV
Face grinding Segments	A 36 GV	A 46 GV
Cylindrical grinding	A 60 KV	B 151 R50 B3* A 60 KV
Internal grinding	A 60 JV	B151 R75 B3* A 60 JV
Profile grinding	A 100 IV	B126 R100 B3* A 100 JV

** We recommend CBN-wheels for this application.*

Machining in hardened condition

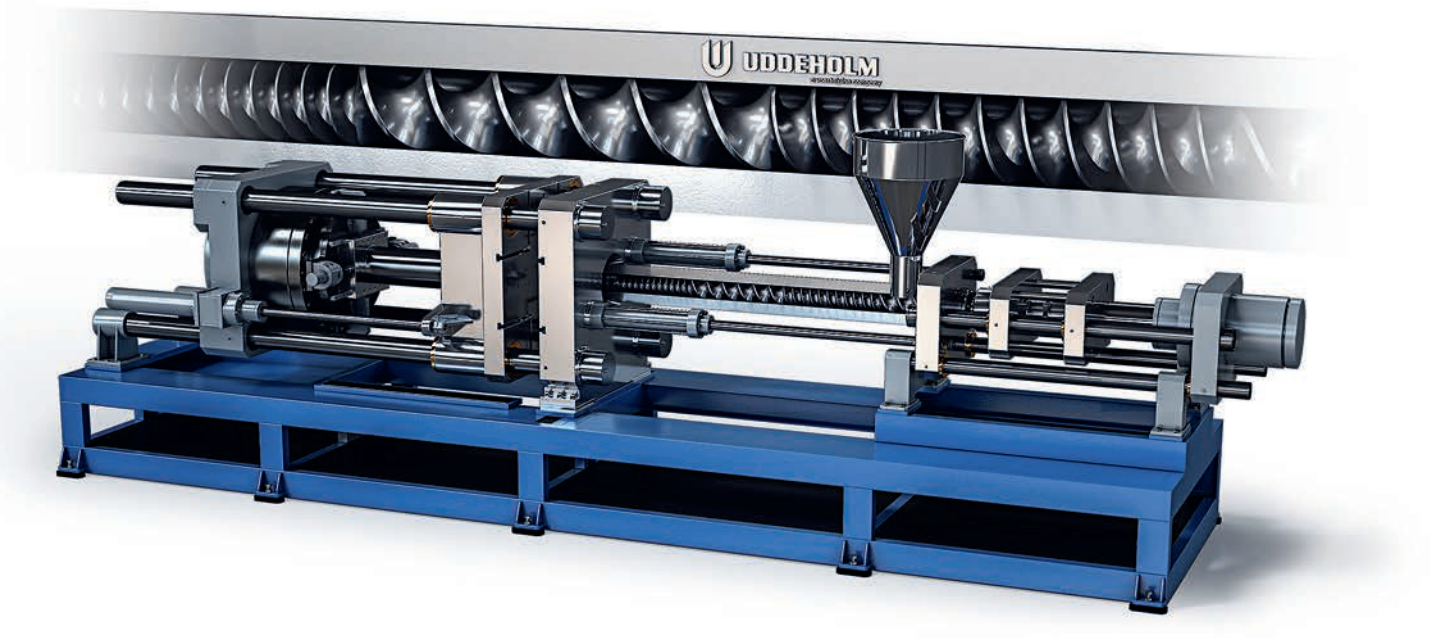
CBN (Cubic boron nitride) or ceramic cutting tools can be used. However, Vanadis 8 XL is best machined using CBN grinding wheels or by electrical discharge machining (EDM).

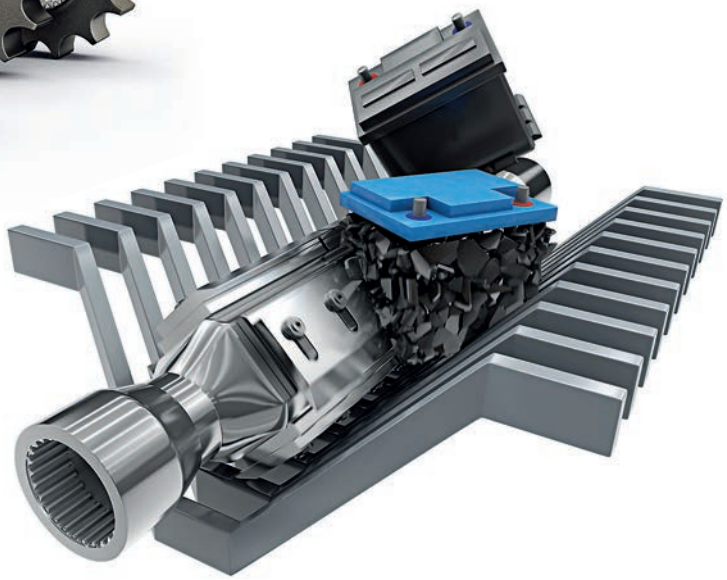
ELECTRICAL DISCHARGE MACHINING – EDM

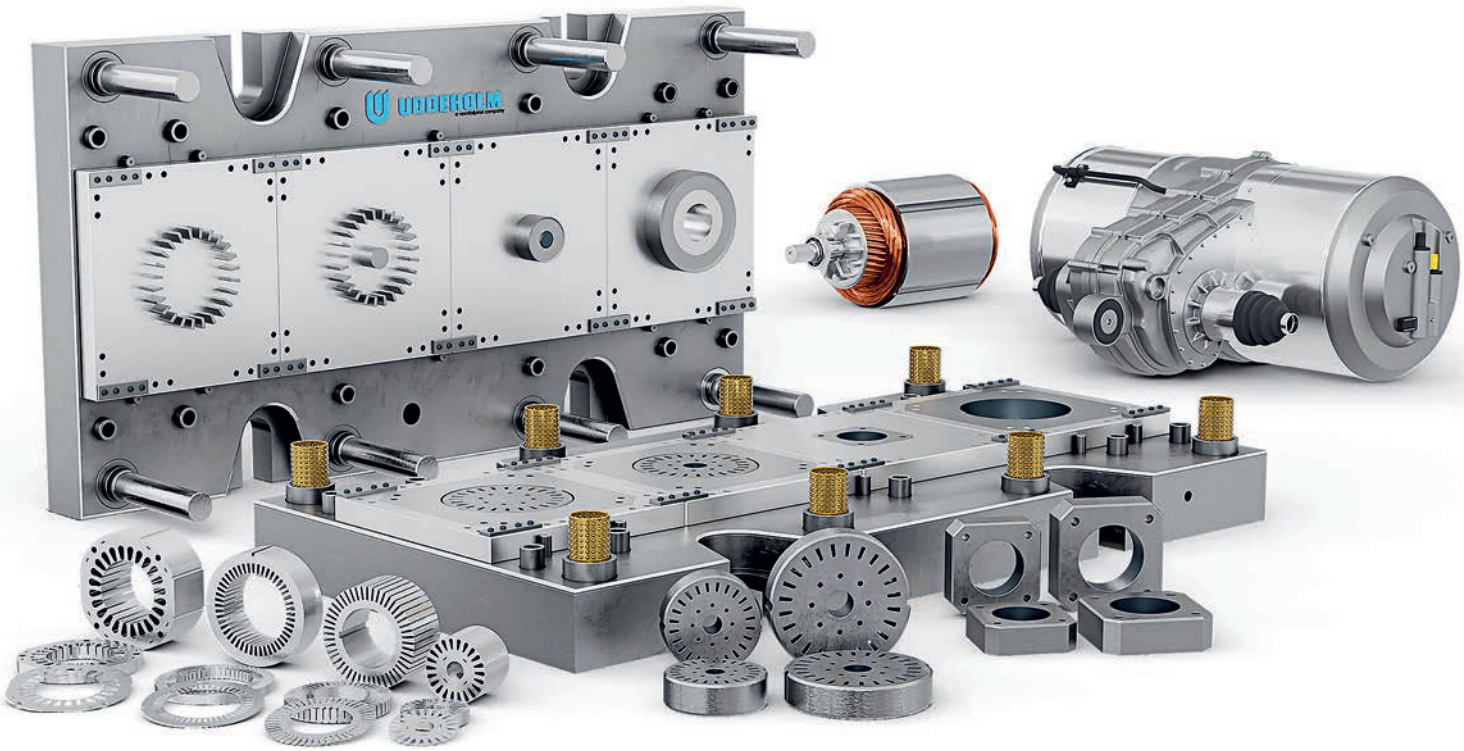
If EDM is performed in the hardened and tempered condition, finish with “fine sparking”, i.e. low current, high frequency.

For optimal performance the EDM’d surface should then be ground/polished, and the tool retempered at approx. 25°C (50°F) lower than the original tempering temperature.

When EDM’ing larger sizes or complicated shapes Uddeholm Vanadis 8 XL should be tempered at high temperatures, above 540°C (1000°F).





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Manufacturing solutions for generations to come

SHAPING THE WORLD®

We are shaping the world together whit the global manufacturing industy. Uddeholm manufactures steel that shapes products used in our evey day life. We do it sustainably, fair to people and the environment. Enabling us to continue shaping the world – today and for generations to come.

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