

Uddeholm Premium Steel for Knives
RETAIN YOUR EDGE



UDDEHOLM KNIFE STEEL AWARDS

YEAR	BLADESHOW PRICE / AWARD
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2016	Overall Knife of the Year
2014	Overall Knife of the Year
2014	Manufacturing Quality Award
2011	Collaboration of the Year
2010	American made Knife of the Year
2010	Most Innovative Imported Design
2009	American made Knife of the Year

A CUT ABOVE THE REST

UDDEHOLM PREMIUM TOOL STEEL FOR KNIVES

Uddeholm is the world leader in the development and production of premium tool steel for the manufacturing industry. Products used in your everyday life, like your car, dishwasher or lawn mower, all contain parts that have been cut out and formed using tools made from Uddeholm steel. Stringent modern demands on productivity and the cutting of difficult and hard work materials, have inspired us to develop the best tool steel in the world. If we can improve tool performance in the most demanding industrial applications, imagine what it can do for your knife blade performance.

CLEAN, CLEANER, SUPERCLEAN

Uddeholm has state-of-the-art steel making facilities. Among them is one of the world's most modern plants for powder metallurgical steel, where the steel making process is a triple update from standard levels. That's why we call our PM grades SuperClean. For knife manufacturers it means steel that enables sharper edges, tougher blades and trouble-free production with excellent grinding and polishing properties.

EDGE RETENTION

WEAR RESISTANCE

High carbide density provides resistance against wear. PM steel has a high amount of vanadium carbides, which are twice as hard as chromium carbide found in conventional steel.

EDGE STABILITY

Edge chipping is minimised with a high level of purity and a uniform structure. The carbides found in PM steel are smaller and rounder than those in conventional steel, meaning no weak points. Edge rolling and impact damage are minimised through high hardness and high cleanliness.

EDGE ANGLE

A high hardness PM steel can be ground to a smaller, hence sharper edge angle without the risk of roll over the edge. Especially suited for chefs' knives.



Uddeholm Elmax used in Spyderco's knife LionSpy, produced by LionSteel.

**PREMIUM STEEL
FOR EVERYDAY USE**



Uddeholm Vanax[®] SuperClean

A TRUE REVOLUTION IN THE WORLD OF KNIFE STEEL

Corrosion resistance as good as 300 series stainless steel, wear resistance and edge retention of vanadium alloyed PM steel? Sounds like a dream come true for any real knife enthusiast.

In Uddeholm Vanax we have made this happen with a revolutionary method of replacing most of the carbon with nitrogen to optimise the amount of chromium in solid solution. The nitrogen forms extremely small (<1 µm) and hard vanadium nitrides, enabling a great combination of wear resistance, edge retention, grindability and toughness.

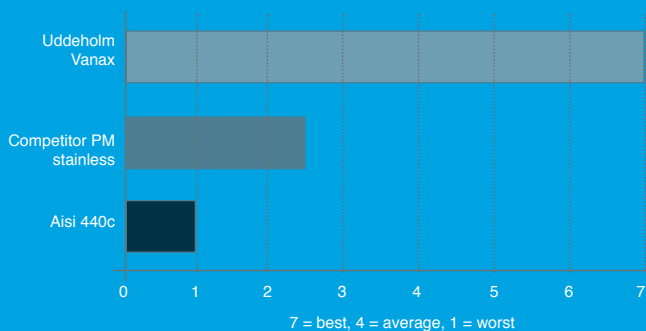
Uddeholm Vanax, with its excellent corrosion resistance and toughness, is the most innovative powder metallurgical knife steel on the market today. It is perfectly suited for the most demanding applications, like salt-water tactical knives, as it gives an outstanding blade that retains its edge, regardless if used in corrosive and high wear environments, with a minimum need of maintenance.



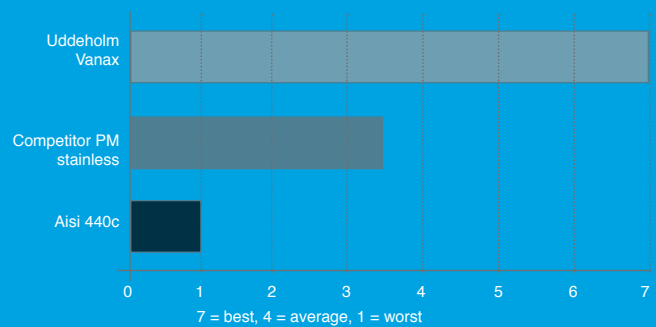
Uddeholm Vanax is excellent for chef knives and kitchen knives.

Relative property profile for Uddeholm Vanax[®] SuperClean (at recommended hardness)

Corrosion resistance



Machinability and grinding



**DEVELOPED
FOR ACTIVE USE**



Uddeholm Elmax[®] SuperClean

THE BEST ALL-ROUND KNIFE STEEL

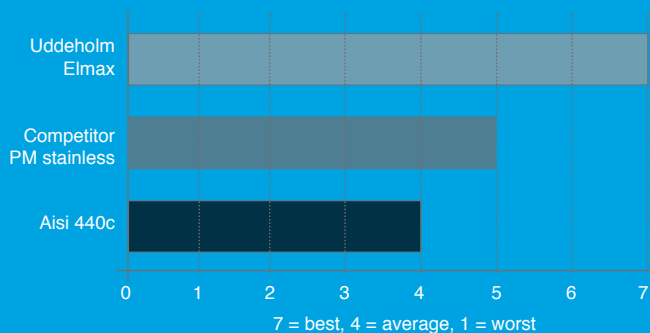
Uddeholm Elmax is a perfectly balanced PM grade which has been designed to reach a hardness well over 60 HRC with good corrosion resistance and excellent edge retention. The superclean production process combined with small sized powder and carbides guarantees trouble-free grinding and polishing. Our process and powder properties also ensure a super fine edge and that it can be ground even at hardnesses up to 62 HRC. This means that the final grinding can be done after hardening, eliminating heat treatment related risks such as distortion and surface decarburization. It also means maximised toughness and a minimised risk for edge chipping.

Internal lab toughness tests have shown that Elmax, even at maximum hardness, outperforms other stainless PM knife grades, regardless of their hardness.

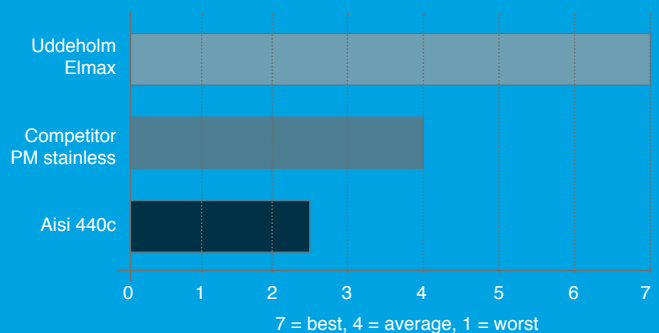


Relative property profile for Uddeholm Elmax[®] SuperClean (at recommended hardness)

Wear resistance and edge retention



Toughness



**PUTS YOUR KNIFE
ON THE TOP**



Uddeholm Vanadis® 4 Extra SuperClean

THE RELIABLE CHOICE

A PM tool steel grade designed for maximum toughness and recommended for use in tactical utility knives, where high reliability is needed. Although it can be hardened to 64 HRC, the recommended hardness range is 58–62 HRC.

Uddeholm Vanadis 8® SuperClean

WHEN WEAR RESISTANCE IS THE KEY

Uddeholm Vanadis 8 has a very high alloy content with 8% vanadium and a hardness of 60-64 HRC that makes this our most wear-resistant PM grade. The high wear resistance of Uddeholm Vanadis 8 is combined with excellent chipping resistance and toughness. This makes Uddeholm Vanadis 8 suitable for knives where abrasive wear is predominant.

Uddeholm Sleipner®

A UNIVERSAL KNIFE STEEL

Uddeholm's modern version of the classic D2/W1.2379 tool steel with improved toughness to better fit active knife use. Even though this is not a PM steel, the finer steel structure in Uddeholm Sleipner gives better machinability, polishability and edge retention. The hardness range is 58–64 HRC.

TECHNICAL GUIDELINES

CHEMICAL COMPOSITION

Uddeholm Vanax

	C	N	Cr	Mo	V
ANALYSIS %	0.36	1.55	18.2	1.1	3.5

The high content of soluble chromium, molybdenum and nitrogen in the matrix results in Uddeholm Vanax's excellent corrosion properties.

Uddeholm Elmax

	C	Cr	Mo	V
ANALYSIS %	1.7	18.0	1.0	3.0

The high chromium content gives Uddeholm Elmax good corrosion resistance. The addition of vanadium and high carbon content improve hardness and abrasive wear resistance.

Uddeholm Vanadis 4 Extra

	C	Cr	Mo	V
ANALYSIS %	1.4	4.7	3.5	3.7

The alloy design and combination of carbon and vanadium are balanced to form a relatively low amount of small but very hard vanadium carbides. This results in a steel with good wear resistance and maximised toughness.

Uddeholm Vanadis 8

	C	Si	Mn	Cr	Mo	V
ANALYSIS %	2.3	0.4	0.4	4.8	3.6	8

The combination of a very high carbon content with a high amount of chromium and vanadium leads to the formation of a very large volume of chromium and vanadium carbides. This gives the high wear resistance.

Uddeholm Sleipner

	C	Mn	Cr	Mo	V
ANALYSIS %	0.9	0.55	7.8	2.5	0.5

A tool steel with properties well suited for knives. Good wear resistance, good resistance to chipping and high compressive strength give a knife with good edge retention.

HEAT TREATMENT

Uddeholm Vanax and Uddeholm Elmax

Uddeholm Vanax and Uddeholm Elmax are heat treated according to normal procedures with regard to soft annealing, stress relieving, hardening and tempering. However, to achieve maximum hardness, it is important to use as high a quenching speed as possible. In a vacuum furnace, we recommend using a minimum of 4 bar quench, and ensuring that the furnace is loaded properly and not overfilled. It is also possible to use other quenching media, such as oil and salt bath. Low-temperature tempering is recommended to ensure good corrosion resistance, but if necessary, clamp tempering can be used in the range 450–500°C (840–930°F).

Both grades have a thin layer of 300 series stainless capsule material on the surface, which protects the PM steel during the manufacturing process. It is recommended to remove

this layer before hardening. The reason is that it will act as an insulation and the result could be a lower hardness. The recommended machining allowance is 0.2 mm (0.008") per side. Bevel grinding can still be performed after heat treatment. For Uddeholm Vanax it is recommended to apply a nitrogen partial pressure of 150-200 mbar to counteract loss of N on the surface. If grinding is performed after heat treatment, 0.2 mm (0.008") should still be removed at some stage in the production process to ensure full removal of the capsule material.

Uddeholm Vanadis and Uddeholm Sleipner

The Uddeholm Vanadis and Uddeholm Sleipner series are heat treated according to normal procedures. As they are non-stainless, high-temperature tempering is recommended. Therefore deep cooling is no longer necessary to attain full hardness.

RECOMMENDED HEAT TREATMENT	Austenitizing		CRYO TREATMENT	Tempering		HARDNESS
	■ 30 min holding time	□ 15 min holding time		■ (3x1h)	□ (2x2h)	
Uddeholm Vanax	1080°C (1975°F)	▼	-195°C (-320°F)	200°C (390°F)	▼	60 HRC
Uddeholm Elmax	1040°C (1900°F)	▼	-195°C (-320°F ^{**})	250°C (480°F)	▼	58 HRC
Uddeholm Elmax	1150°C (2100°F)	▼	-195°C (-320°F)	200°C (390°F)	▼	62 HRC
Uddeholm Vanadis 4 Extra	1040°C (1900°F)	▼	–	560°C (1040°F)	▼	62 HRC
Uddeholm Vanadis 8	1180°C (1975°F)	▼	–	540°C (1000°F)	▼	64 HRC
Uddeholm Vanadis 8	1020°C (1868°F)	▼	–	540°C (1000°F)	▼	60 HRC
Uddeholm Sleipner	1150°C (2100°F)	▼	–	540°C (1000°F)	▼	63 HRC
Uddeholm Sleipner	1030°C (1885°F)	▼	–	540°C (1000°F)	▼	59 HRC

* Deep cool immediately after quenching. If liquid nitrogen cannot be used, deep cooling in dry ice to -72°C (-95°F) can be used with a similar result.

** Optional – if not used, toughness is further enhanced, but a loss of 2 HRC can be expected.

GRINDING

A general grinding wheel recommendation is given below. The data are to be considered guidelines and may require adjustments based on equipment, selection of grinding wheel, etc. More information can be found in the Uddeholm brochure Grinding of Tool Steel.

TYPE OF GRINDING	SOFT ANNEALED CONDITION	HARDENED CONDITION
Face grinding straight wheel	a 46 HV	B 151 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 JV
Internal grinding	a 60 JV	B 151 R75 B3' A 60 IV
Profile grinding	A 100 IV	B 126 R100 B6' A 100 JV

* Use CBN wheels for long production series

#1 IN HIGH PERFORMANCE TOOL STEEL

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, #1 in high performance tool steel.