Uddeholm Vanadis® 8 SuperClean

UDDEHOLM

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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SS-EN ISO 9001
SS-EN ISO 14001

CRITICAL TOOL STEEL PROPERTIES

FOR GOOD TOOL PERFORMANCE

- Correct hardness for the application
- Very high wear resistance
- Sufficient toughness to prevent premature failure due to chipping/crack formation

High wear resistance is often associated with low toughness and vice-versa. However, for optimal tool performance both high wear resistance and toughness are essential in many cases.

Uddeholm Vanadis 8 SuperClean is a powder metallurgical cold work tool steel offering a combination of extremely high wear resistance and good toughness.

FOR TOOLMAKING

- Machinability
- Heat treatment
- Dimensional stability in heat treatment
- Surface treatment

Toolmaking with highly alloyed steels means that machining and heat treatment are often more of a problem than with the lower alloyed grades. This can, of course, raise the cost of toolmaking.

Due to the very carefully balanced alloying and the powder metallurgical manufacturing route, Uddeholm Vanadis 8 SuperClean has a similar heat treatment procedure to the steel AISI D2. One very big advantage with Uddeholm Vanadis 8 SuperClean is that the dimensional stability after hardening and tempering is much better than for the conventionally produced high performance cold work steels. This also means that Uddeholm Vanadis 8 SuperClean is a tool steel which is very suitable for surface coatings.

APPLICATIONS

Uddeholm Vanadis 8 SuperClean is especially suitable for very long run tooling where abrasive wear is the dominating problem. Its very good combination of extremely high wear resistance and good toughness also make Uddeholm Vanadis 8 SuperClean an interesting alternative in applications where tooling made of such materials as cemented carbide or high speed steels tends to chip or crack.

Examples:

- Blanking and forming
- Fine blanking
- Blanking of electrical sheet
- Gasket stamping
- Deep drawing
- Cold forging
- Slitting knives (paper and foil)
- Powder pressing
- Granulator knives
- Extruder screws etc.

GENERAL

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

- Very high abrasive and adhesive wear resistance
- High compressive strength, 64 HRC
- Very good through-hardening properties
- Good ductility
- Very good stability in hardening
- Good resistance to tempering back
- Good machining and grinding properties

Typical analysis %	C 2.3	Si 0.4	Mn 0.4	Cr 4.8	Mo 3.6	V 8.0
Delivery condition	Soft annealed to ≤ 270 HB					
Colour code	Green/light violet					

PROPERTIES

PHYSICAL DATA

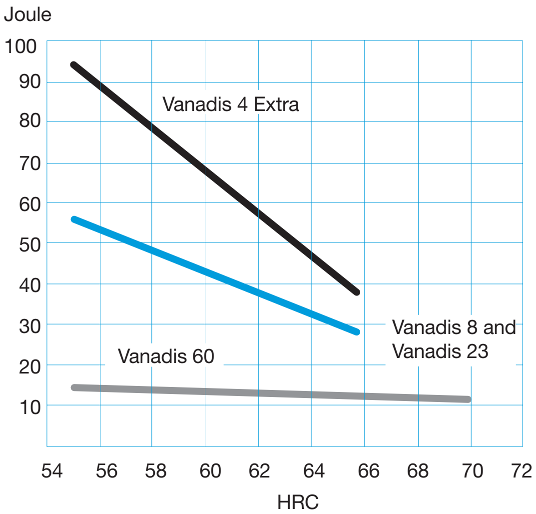
Hardened and tempered to 62 HRC.

Temperature	20°C (68°F)	200°C (390°F)	400°C (750°F)
Density kg/m^3 lbs/in^3	7 460 0.270	–	–
Modulus of elasticity N/mm^2 psi	230 000 33.8×10^6	210 000 31.9×10^6	200 000 29.7×10^6
Coefficient of thermal expansion per pro °C ab 20°C °F from 68°F	–	10.8×10^{-6} 6.0×10^{-6}	11.6×10^{-6} 6.5×10^{-6}
Thermal conductivity W/m • °C Btu in/(ft^2 h °F)	–	25 173	28 194
Specific heat J/kg °C Btu/lb °F	470 0.11	–	–

DUCTILITY

Impact test, unnotched, CR2 (thickness direction).

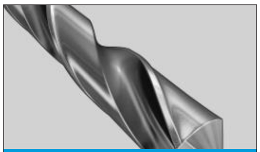
The impact strengths shown, are average values. Uddeholm Vanadis 8 SuperClean and Uddeholm Vanadis 23 SuperClean have a similar impact strength.

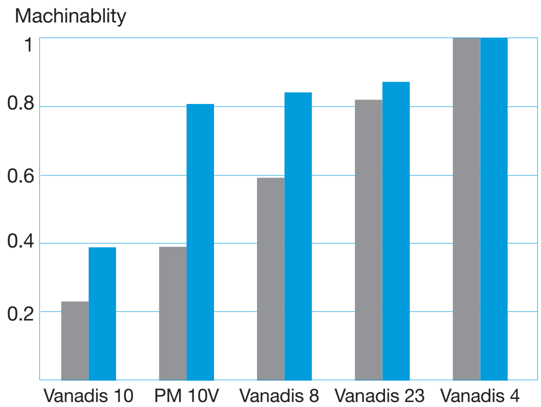


MACHINABILITY

Relative machinability for Uddeholm PM SuperClean steels Vanadis 10, Vanadis 8, Vanadis 23 and Vanadis 4 Extra compared with a 10% Vanadium steel from another producer, PM10V.


Turning uncoated carbide


Drilling uncoated HSS



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

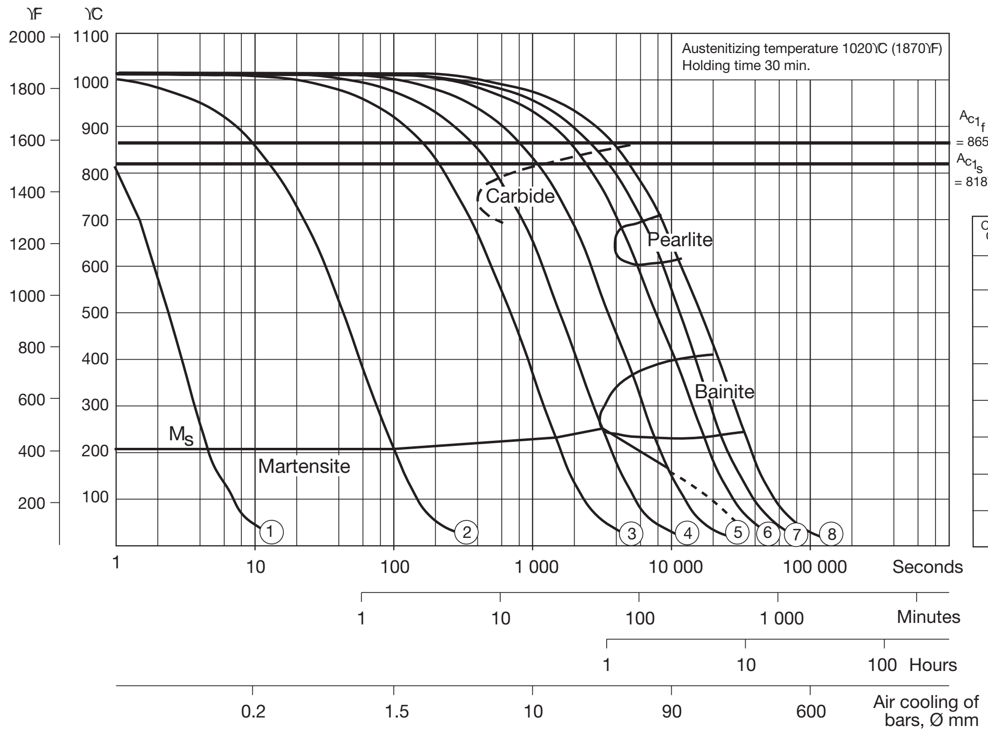
Note: Temper the tool as soon as its temperature reaches 50–70°C (120–160°F). In order to obtain the optimum properties for the tool, the cooling rate should be as fast as possible with regards to acceptable distortion.

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-GRAPH

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



Cooling Curve No.	Hardness HV 10	$T_{800-500}$ (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

TEMPERING

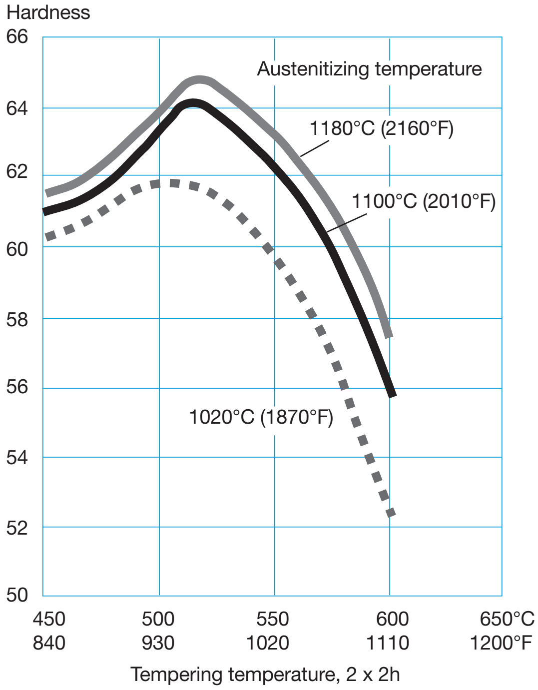
Choose the tempering temperature according to the hardness required by reference to the tempering graph. Temper at least twice with intermediate cooling to room temperature.

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

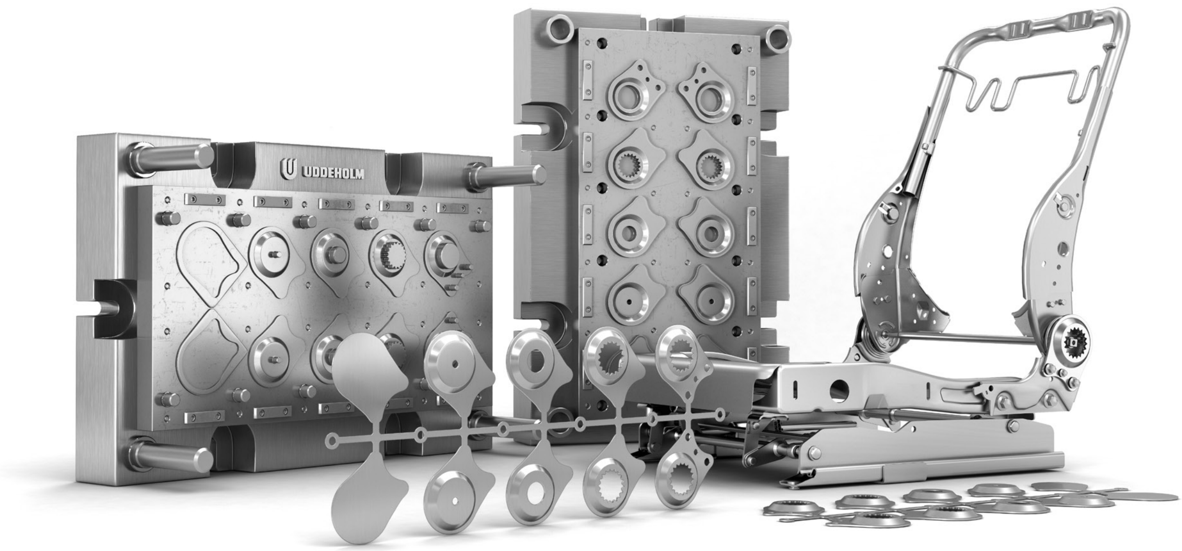
Tempering at a lower temperature than 540°C (1000°F) may increase the hardness and compressive strength to some extent but also impair cracking resistance and dimensional stability. However, if lowering the tempering temperature, do not temper below 520°C (970°F).

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

TEMPERING GRAPH



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.



CUTTING DATA RECOMMENDATIONS

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".

Delivery condition: Soft annealed to ≤270 HB

TURNING

Cutting data parameter	Turning with carbide Rough turning	Turning with carbide Fine turning	Turning with high speed steel Fine turning
Cutting speed (v_c) m/min f.p.m.	70–100 230–330	100–120 330–395	8–10 28–22
Feed (f) mm/rev i.p.r.	0.2–0.4 0.008–0.016	0.05–0.2 0.002–0.008	0.05–0.3 0.002–0.012
Depth of cut (a_p) mm inch	2–4 0.08–0.16	0.5–2 0.02–0.08	0.5–3 0.02–0.12
Carbide designation ISO	* K20, P10–P20 C2, C7–C6	* K15, P10 C3, C7	–

* Use a wear resistant Al_2O_3-coated carbide grade

DRILLING

HIGH SPEED STEEL TWIST DRILL

Drill diameter mm	Drill diameter inch	Cutting speed, v_c m/min	Cutting speed, v_c f.p.m.	Feed (f) mm/rev	Feed (f) i.p.r.
– 5	– 3/16	8–10*	26–33*	0.05–0.15	0.002–0.006
5–10	3/16–3/8	8–10*	26–33*	0.15–0.20	0.006–0.008
10–15	3/8–5/8	8–10*	26–33*	0.20–0.25	0.008–0.010
15–20	5/8–3/4	8–10*	26–33*	0.25–0.35	0.010–0.014

* For coated HSS drill v_c = 14–16 m/min. (46–52 f.p.m.)

CARBIDE DRILL

Cutting data parameters	Type of drill: Indexable insert	Type of drill: Solid carbide	Type of drill: Carbide tip[1]
Cutting speed (v_c) m/min. f.p.m.	90–120 300–395	50–70 164–230	25–35 82–115
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]	0.15–0.25[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 carbide Rough milling	Milling with carbide Fine milling
Cutting speed (v_c) m/min. f.p.m.	40–70 130–230	70–100 230–330
Feed (f_z) mm/tooth in/tooth	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	1–2 0.04–0.08
Carbide designation ISO	* K20, P10–P20 C3, C7–C6	* K15, P10 C3, C7

* Use a wear resistant Al_2O_3-coated carbide grade

END MILLING

Cutting data parameter	Type of mill: Solid carbide	Type of mill: Carbide indexable insert	Type of mill: High speed steel[1]
Cutting speed (v_c) m/min. f.p.m.	35–45 115–148	70–90 200–260	5–8[1] 16–26[1]
Feed (f_z) mm/tooth in/tooth	0.01–0.2[2] 0.0004–0.008[2]	0.06–0.20[2] 0.002–0.008[2]	0.01–0.3[2] 0.0004–0.012[2]
Carbide designation ISO	–	[3] K15 P10–P20 C3, C7–C6	–

[1] For coated HSS end mill v_c = 12–16 m/min. (39–52 f.p.m.)
[2] Depending on radial depth of cut and cutter diameter
[3] Use a wear resistant Al_2O_3-coated carbide grade

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	B151 R50 B3* A 60 KV
Internal grinding	A 60 JV	B151 R75 B3* A 60 JV
Profile grinding	A 100 IV	B126 R100 B6* A 100 JV

* If possible, use CBN-wheels for this application

ELECTRICAL DISCHARGE MACHINING — EDM

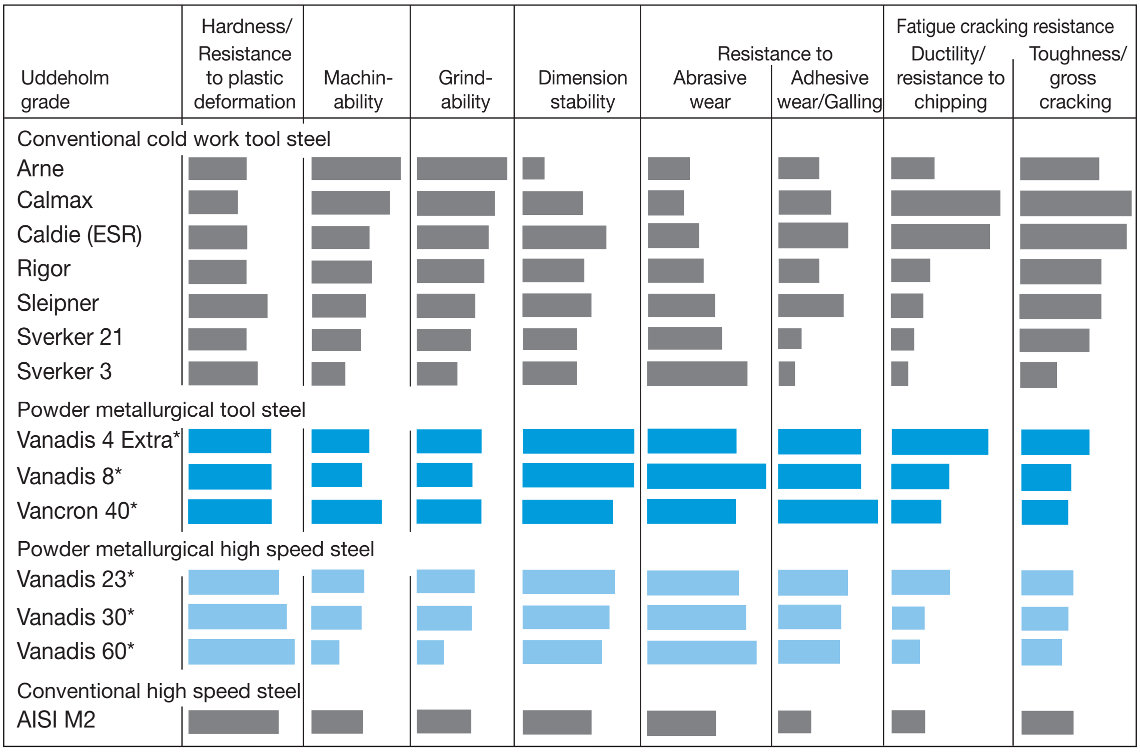
If EDM is performed in the hardened and tempered condition, finish with "fine-sparking", i.e. low current, high frequency.

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 SuperClean should be tempered at high temperatures, above 540°C (1000°F).

RELATIVE COMPARISON OF UDDEHOLM COLD WORK TOOL STEEL

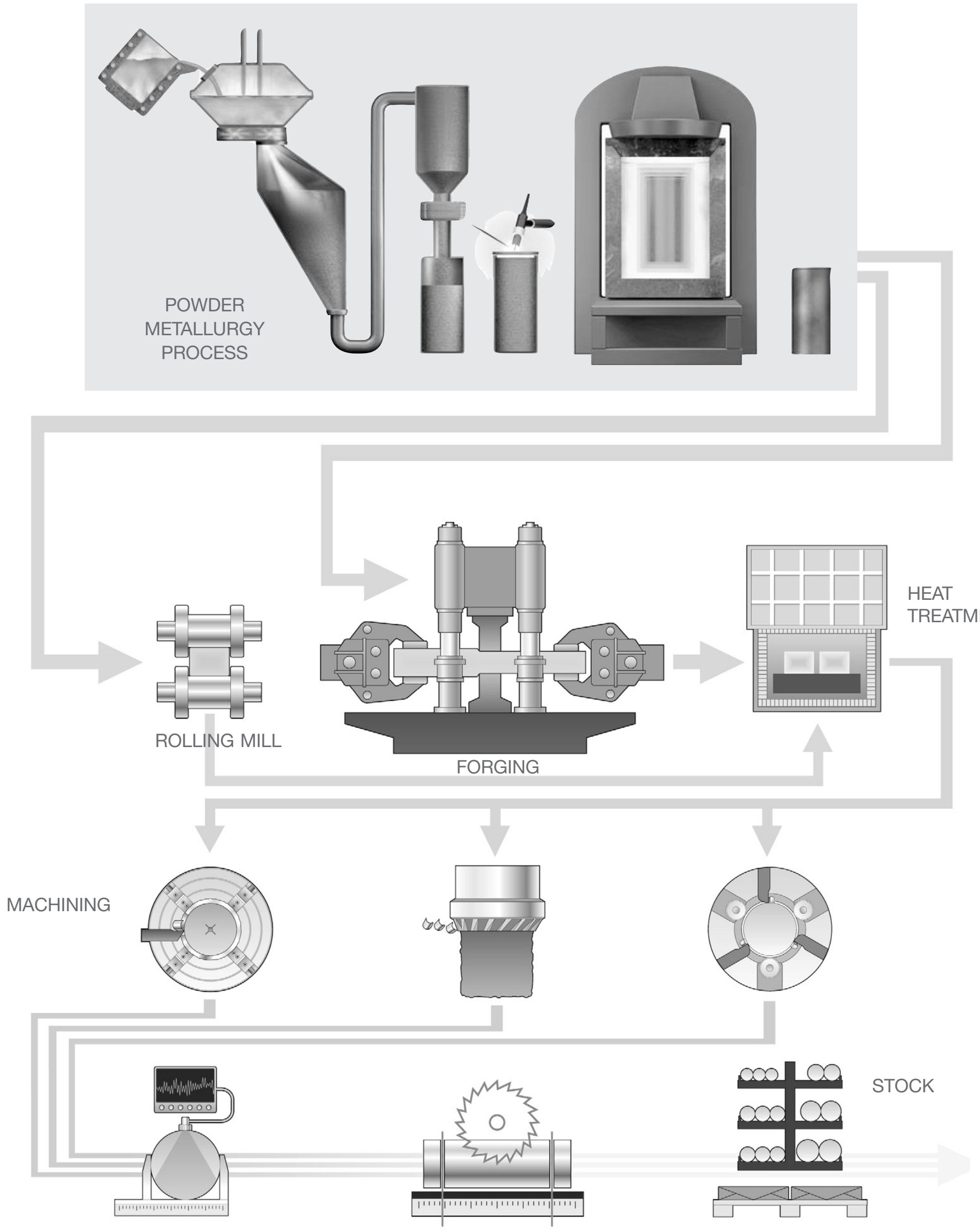
MATERIAL PROPERTIES AND RESISTANCE TO FAILLURE MECHANISMS



* Uddeholm PM SuperClean tool steels

FURTHER INFORMATION

Please contact your local Uddeholm office for further information on the selection, heat treatment, application and availability of Uddeholm tool steel.



THE POWDER METALLURGY PROCESS

In the powder metallurgy process nitrogen gas is used to atomise the melted steel into small droplets, or grains. Each of these small grains solidifies quickly and there is little time for carbides to grow. These powder grains are then compacted to an ingot in a hot isostatic press (HIP) at high temperature and pressure. The ingot is then rolled or forged to steel bars by conventional methods.

The resulting structure is completely homogeneous steel with randomly distributed small carbides, harmless as sites for crack initiation but still protecting the tool from wear.

Large slag inclusions can take the role as sites for crack initiation instead. Therefore, the powder metallurgical process has been further developed in stages to improve the cleanliness of the steel. Powder steel from Uddeholm is today of the third generation and is considered the cleanest powder metallurgy tool steel product on the market.

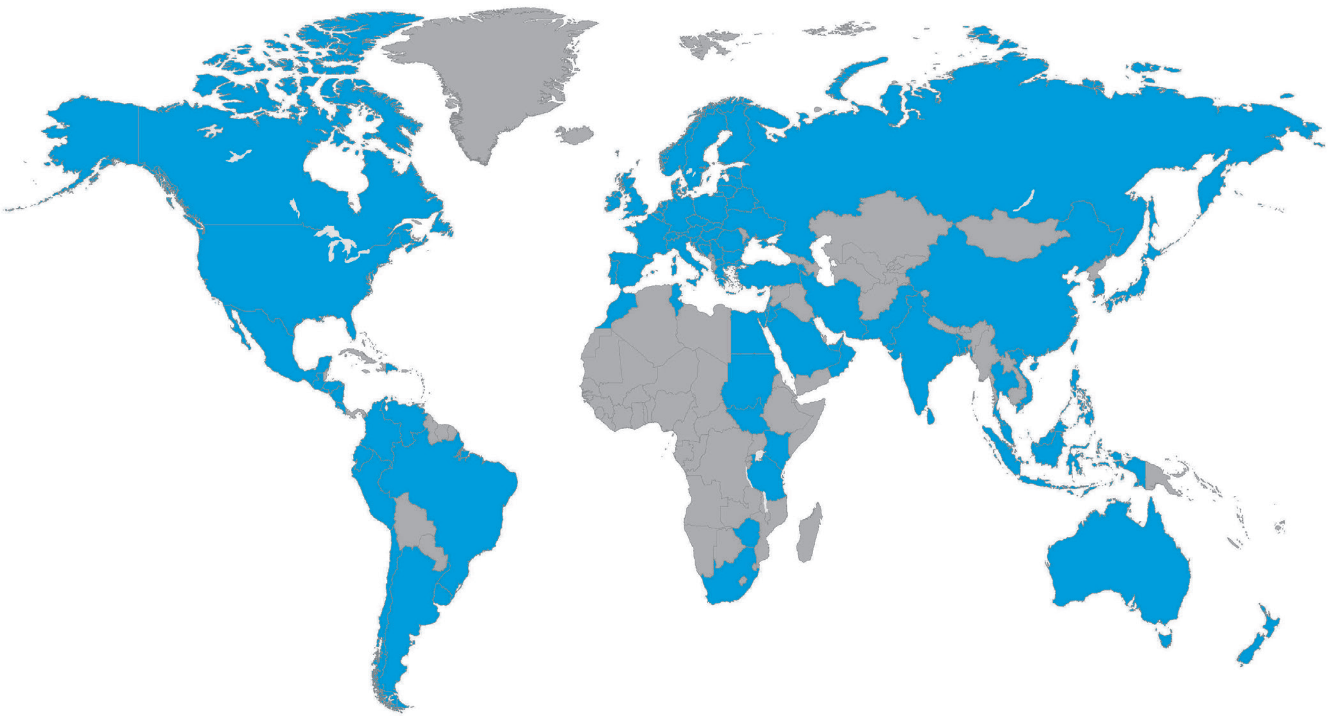
HEAT TREATMENT

Prior to delivery all of the different bar materials are subjected to a heat treatment operation, either as soft annealing or hardening and tempering. These operations provide the steel with the right balance between hardness and toughness.

MACHINING

Before the material is finished and put into stock, we also rough machine the bar profiles to required size and exact tolerances. In the lathe machining of large dimensions, the steel bar rotates against a stationary cutting tool. In peeling of smaller dimensions, the cutting tools revolve around the bar.

To safeguard our quality and guarantee the integrity of the tool steel we perform both surface- and ultrasonic inspections on all bars. We then remove the bar ends and any defects found during the inspection.



NETWORK OF EXCELLENCE

Uddeholm is present on every continent. This ensures you high-quality Swedish tool steel and local support wherever you are. We secure our position as the world's leading supplier of tooling materials.

UDDEHOLM

Uddeholm is the world's leading supplier of tooling materials. This is a position we have reached by improving our customers' everyday business. Long tradition combined with research and product development equips Uddeholm to solve any tooling problem that may arise. It is a challenging process, but the goal is clear – to be your number one partner and tool steel provider.

Our presence on every continent guarantees you the same high quality wherever you are. We secure our position as the world's leading supplier of tooling materials. We act worldwide. For us it is all a matter of trust – in long-term partnerships as well as in developing new products.

For more information, please visit www.uddeholm.com

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