VANADIS 8 SUPERCLEAN

UDDEHOLM VANADIS 8 SUPERCLEAN

ASSAB	UDDEHOLM a voestalpine company	REFERENCE STANDARD		
		AISI	WNr.	JIS
ASSAB DF-3	ARNE	O1	1.2510	SKS 3
ASSAB XW-10	RIGOR	A2	1.2363	SKD 12
ASSAB XW-42	SVERKER 21	D2	1.2379	(SKD 11)
CALMAX / CARMO	CALMAX / CARMO		1.2358	
VIKING	VIKING / CHIPPER		(1.2631)	
CALDIE	CALDIE			
ASSAB 88	SLEIPNER			
ASSAB PM 23 SUPERCLEAN	VANADIS 23 SUPERCLEAN	(M3:2)	1.3395	(SKH 53)
ASSAB PM 30 SUPERCLEAN	VANADIS 30 SUPERCLEAN	(M3:2 + Co)	1.3294	SKH 40
ASSAB PM 60 SUPERCLEAN	VANADIS 60 SUPERCLEAN		(1.3292)	
VANADIS 4 EXTRA SUPERCLEAN	VANADIS 4 EXTRA SUPERCLEAN			
VANADIS 8 SUPERCLEAN	VANADIS 8 SUPERCLEAN			
VANCRON SUPERCLEAN	VANCRON SUPERCLEAN			
ELMAX SUPERCLEAN	ELMAX SUPERCLEAN			
VANAX SUPERCLEAN	VANAX SUPERCLEAN			
ASSAB 518		P20	1.2311	
ASSAB 618 T		(P20)	(1.2738)	
ASSAB 618 / 618 HH		(P20)	1.2738	
ASSAB 718 SUPREME / 718 HH	IMPAX SUPREME / IMPAX HH	(P20)	1.2738	
NIMAX / NIMAX ESR	NIMAX / NIMAX ESR			
VIDAR 1 ESR	VIDAR 1 ESR	H11	1.2343	SKD 6
UNIMAX	UNIMAX			
CORRAX	CORRAX			
ASSAB 2083		420	1.2083	SUS 420J2
STAVAX ESR	STAVAX ESR	(420)	(1.2083)	(SUS 420J2)
MIRRAX ESR	MIRRAX ESR	(420)		
MIRRAX 40	MIRRAX 40	(420)		
TYRAX ESR	TYRAX ESR			
POLMAX	POLMAX	(420)	(1.2083)	(SUS 420J2)
ROYALLOY	ROYALLOY	(420 F)		
COOLMOULD	COOLMOULD			
ASSAB 2714			1.2714	SKT 4
ASSAB 2344		H13	1.2344	SKD 61
ASSAB 8407 2M	ORVAR 2M	H13	1.2344	SKD 61
ASSAB 8407 SUPREME	ORVAR SUPREME	H13 Premium	1.2344	SKD 61
DIEVAR	DIEVAR			
QRO 90 SUPREME	QRO 90 SUPREME			
FORMVAR	FORMVAR			

( ) - modified grade

Edition 20210809

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.

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, Vanadis 8 SuperClean has a similar heat treatment procedure to the steel AISI D2. One very big advantage with 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 Vanadis 8 SuperClean is a tool steel which is very suitable for surface coatings.

APPLICATIONS

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 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

Vanadis 8 SuperClean is a chromium-molybdenum-vanadium alloyed steel which is characterised 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					

PROPERTIES

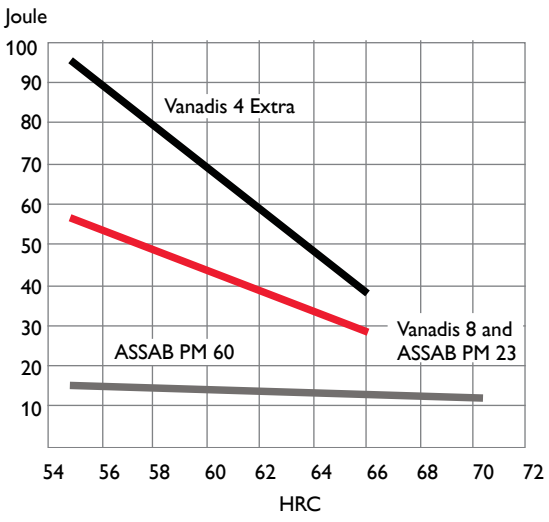
PHYSICAL DATA

Hardened and tempered to 62 HRC.

Temperature	20°C	200°C	400°C
Density kg/m³	7 460	-	-
Modulus of elasticity MPa	230 000	210 000	200 000
Coefficient of thermal expansion /°C from 20°C	-	10.8×10^{-6}	11.6×10^{-6}
Thermal conductivity W/m°C	-	25	28
Specific heat J/kg°C	470	-	

DUCTILITY

Impact test unnotched, CR2 (thickness direction). The impact strengths shown, are average values. Vanadis 8 SuperClean and ASSAB PM 23 SuperClean have a similar impact strength.

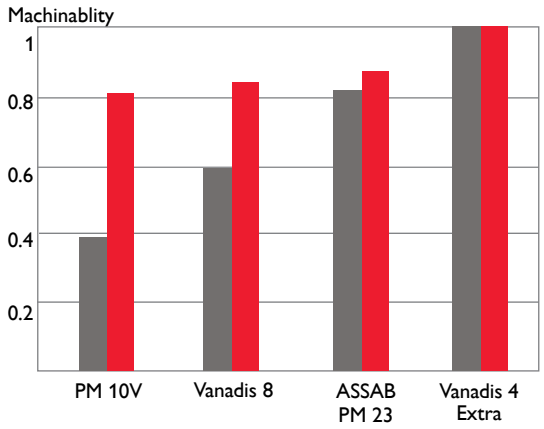


MACHINABILITY

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


Turning uncoated carbide


Drilling uncoated HSS



HEAT TREATMENT

STRESS RELIEVING

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

HARDENING

Pre-heating temperature: First preheating at 600 – 650°C and second at 850 – 900°C

Austenitising temperature: 1020 – 1180°C

Holding time: 30 minutes for hardening temperatures up to 1100°C, 15 minutes for temperatures higher than 1100°C.

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 decarburisation and oxidation during hardening.

QUENCHING MEDIA

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

Note: Temper the tool as soon as its temperature reaches 50 – 70°C.

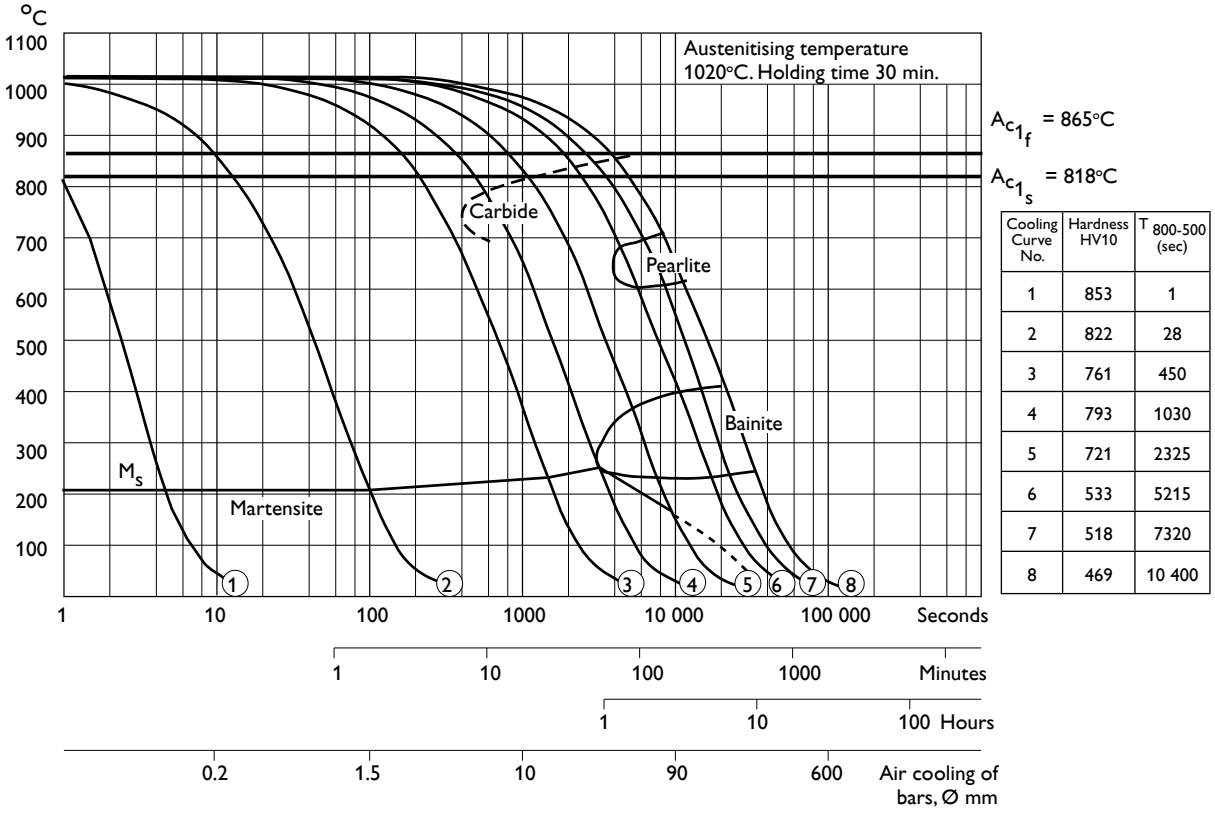
In order to obtain the optimum properties for the tool, the cooling rate should be as fast as possible with regards to acceptable distortion.

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.

CCT-GRAPH

Austenitising temperature 1020°C. Holding time 30 minutes.



Cooling Curve No.	Hardness HV10	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	10 400

TEMPERING

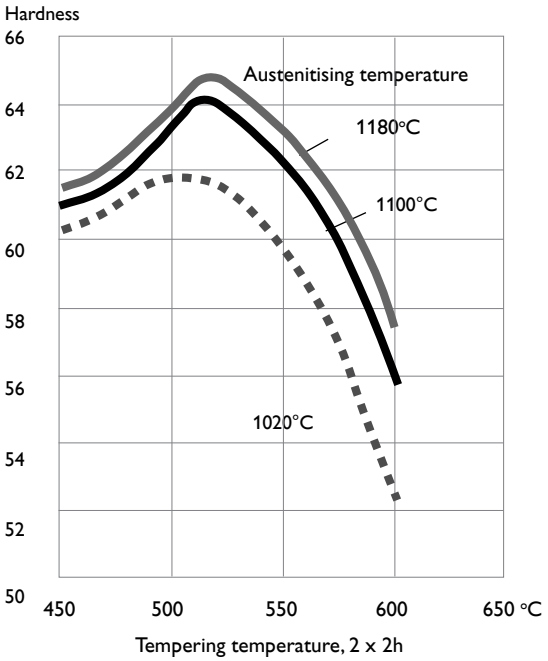
Choose the tempering temperature according to the hardness required by reference to the tempering graph. Temper at least twice with intermediate cooling to room temperature.

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

Tempering at a lower temperature than 540°C 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.

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.
Delivery condition: Soft annealed to ≤ 270 HB

TURNING

Cutting data parameter	Turning with carbide		Turning with high speed steel
	Rough turning	Fine turning	Fine turning
Cutting speed (V_c) m/min	70 – 100	100 – 120	8 – 10
Feed (f) mm/rev	0.2 – 0.4	0.05 – 0.2	0.05 – 0.3
Depth of cut (a_p) mm	2 – 4	0.5 – 2	0.5 – 3
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	Cutting speed (Vc) m/min	Feed (f) mm/rev
≤ 5	8 – 10*	0.05 – 0.15
5–10	8 – 10*	0.15 – 0.20
10–15	8 – 10*	0.20 – 0.25
15–20	8 – 10*	0.25 – 0.35

* For coated HSS drill v_c = 14–16 m/min.

CARBIDE DRILL

Cutting data parameter	Type of drill		
	Indexable insert	Solid carbide	Carbide tip [1]
Cutting speed (V_c) m/min	90 – 120	50 – 70	25 – 35
Feed. (f) mm/rev	0.05 – 0.15 [2]	0.08 – 0.20 [3]	0.15 – 0.25 [4]

[1] Drill with replaceable or brazed carbide tip
[2] Feed rate for drill diameter 20 – 40 mm
[3] Feed rate for drill diameter 5 – 20 mm
[4] Feed rate for drill diameter 10 – 20 mm

MILLING

FACE AND SQUARE SHOULDER MILLING

Cutting data parameter	Turning with carbide	
	Rough milling	Fine milling
Cutting speed (V_c) m/min	40 – 70	70 – 100
Feed (f) mm/tooth	0.2 – 0.4	0.1 – 0.2
Depth of cut (a_p) mm	2 – 4	1 – 2
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 end mill		
	Solid carbide	Carbide indexable insert	High speed steel
Cutting speed (V_c) m/min	35 – 45	70 – 90	5 – 8 [1]
Feed. (f) mm/tooth	0.01 – 0.2 [2]	0.06 – 0.20 [2]	0.01 – 0.3 [2]
Carbide designation ISO	–	[3] K15 P10–P20 C3, C7–C6	–

[1] For coated HSS end mill v_c = 12 – 16 m/min.
[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 "Grinding of tool steel" brochure.

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* A60 KV
Internal grinding	A 60 JV	R151 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.

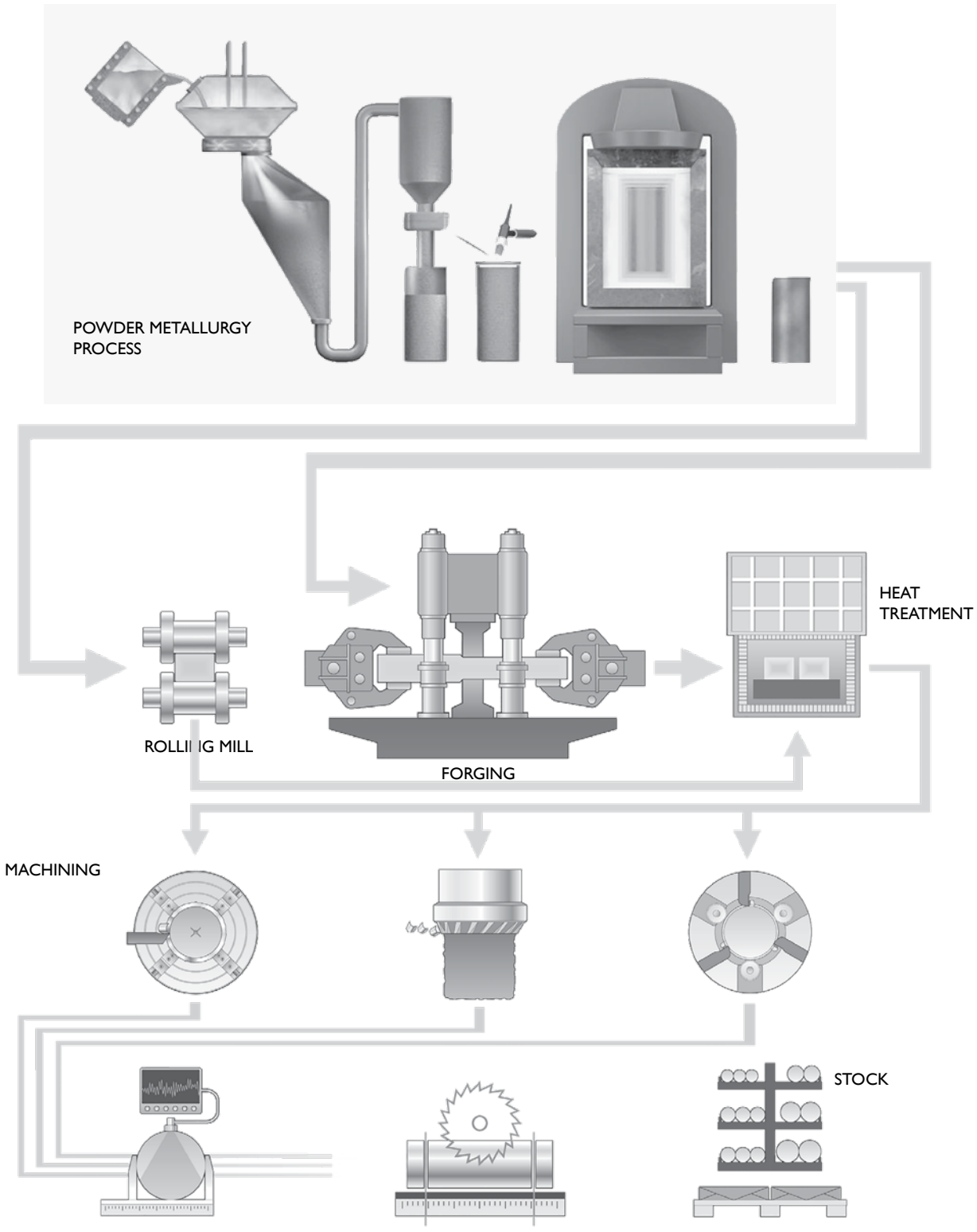
For optimal performance the EDM'd surface should then be ground/polished and the tool retempered at approx. 25°C lower than the original tempering temperature.
When EDM'ing larger sizes or complicated shapes Vanadis 8 SuperClean should be tempered at high temperatures, above 540°C.

RELATIVE COMPARISON OF ASSAB COLD WORK TOOL STEEL

MATERIAL PROPERTIES AND RESISTANCE TO FAILURE MECHANISMS

ASSAB Grade	Hardness/ Resistance to plastic deformation	Machinability	Grindability	Dimension stability	Resistance to		Fatigue cracking resistance	
					Abrasive wear	Adhesive wear/Galling	Ductility/ resistance to chipping	Toughness/ gross cracking
Conventional cold work tool steel								
ASSAB DF-3								
ASSAB XW-10								
ASSAB XW-42								
Calmax								
Caldie (ESR)								
ASSAB 88								
Powder metallurgical tool steel								
Vanadis 4 Extra*								
Vanadis 8*								
Vancron*								
Powder metallurgical high speed steel								
ASSAB PM 23*								
ASSAB PM 30*								
ASSAB PM 60*								
Conventional high speed steel								
ASSAB M2								

* ASSAB PM SuperClean Tool Steel


POWDER METALLURGY
PROCESS
HEAT
TREATMENT
ROLLI IG MILL
FORGING
MACHINING
STOCK

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 and ASSAB 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.

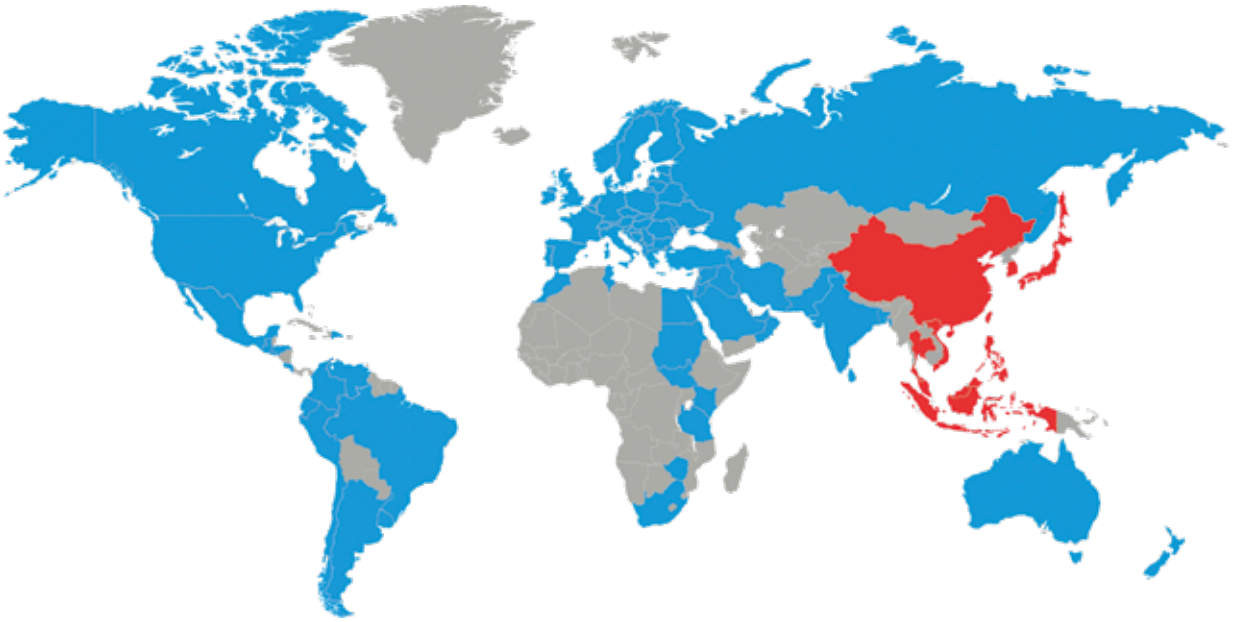
To safeguard our quality and guarantee the integrity of the tool steel we perform both surface- and ultrasonic inspections on all bars. We then remove the bar ends and any defects found during the inspection.

FURTHER INFORMATION

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

ASSAB
SUPERIOR TOOLING SOLUTIONS
A ONE-STOP SHOP

ASSAB is unmatched as a one-stop product and service provider that offers superior tooling solutions. In addition to the supply of tool steel and other special steel, our range of comprehensive value-added services, such as machining, heat treatment and coating services, span the entire supply chain to ensure convenience, accountability and optimal usage of steel for customers. We are committed to achieving solutions for our customers, with a constant eye on time-to-market and total tooling economy.



Choosing the right steel is of vital importance. ASSAB engineers and metallurgists are always ready to assist you in your choice of the optimum steel grade and the best treatment for each application. ASSAB not only supplies steel products with superior quality, we offer state-of-the-art machining, heat treatment and surface treatment services to enhance steel properties to meet your requirement in the shortest lead time. Using a holistic approach as a one-stop solution provider, we are more than just another tool steel supplier.

ASSAB and Uddeholm are present on every continent. This ensures you that high quality tool steel and local support are available wherever you are. Together we secure our position as the world's leading supplier of tooling materials.

For more information, please visit
www.assab.com

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