ASSAB XW-10

UDDEHOLM RIGOR

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 20210505

ASSAB XW-10

PROPERTIES PROFILE

ASSAB XW-10 is a universal medium alloyed cold work tool steel placed between 12 % Cr-steels and carbon tool steel like AISI O1.The steel has an excellent combination of wear and chipping resistance and a hardenability well suited for modern heat treatment processing. ASSAB XW-10 has also excellent machining and grinding properties.

APPLICATIONS

The property profile of ASSAB XW-10 combine to give a steel suitable for the manufacture of medium run tooling for applications where a combination of resistance to abrasive wear and chipping is needed. This makes ASSAB XW-10 a good general purpose cold work tool steel.

GENERAL

ASSAB XW-10 is an air or oil hardening chromium-molybdenum-vanadium alloyed tool steel characterised by:

- Good machinability
- High stability after hardening
- High compressive strength
- Good hardenability
- Good wear resistance

Typical analysis %	C 1.0	Si 0.3	Mn 0.6	Cr 5.3	Mo 1.1	V 0.2
Standard specification	AISI A2. BA2. W.-Nr. 1.2363. Euro X 100 CrMoV 5					
Delivery condition	Soft annealed to approx. 215 HB					

APPLICATIONS

ASSAB XW-10 takes a place in the ASSAB tool steel range between ASSAB DF-3 and ASSAB XW-42, offering an excellent combination of good wear resistance and toughness. It may be regarded, therefore, as a "universal" cold work steel.

For cutting operations the good toughness of ASSAB XW-10 gives excellent resistance to chipping of the cutting edge. In many cases tools made from this steel have given better tooling economy than high-carbon, highchromium steel of the BD3/W.-Nr. 2080 type.

ASSAB XW-10 has much better machining and grinding properties.

CUTTING

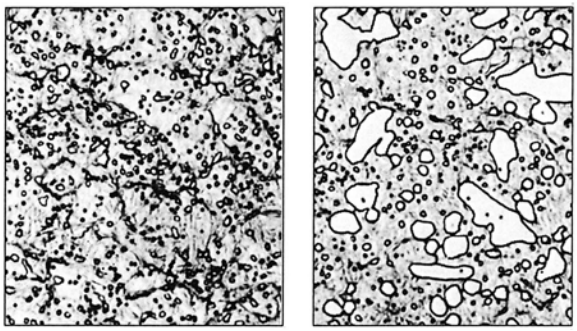
	Material thickness, mm	Hardness, HRC
Tools for: Blanking, punching, piercing, cropping, shearing, trimming, clipping	up to 3 mm	60-62
	3-6 mm	56-60
	6-10 mm	54-56
Short cold sheears Rotary shear blades for plastic waste		56-60
Clipping, timming tools for forgings	Hot	58-60
	Cold	56-58

FORMING

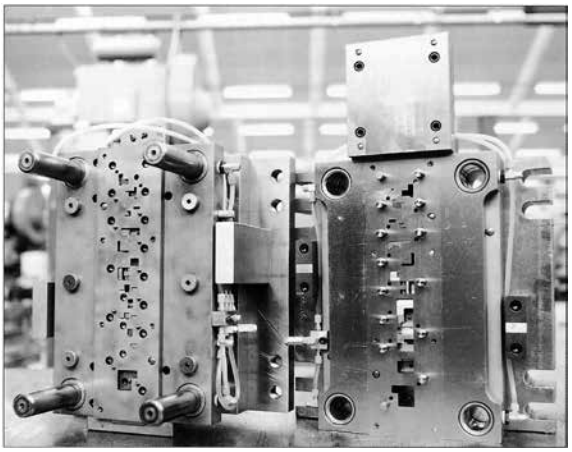
	Hardness HRC
Tools for: Blending, raising, deep-drawing, rim-rolling, spinning and flow-turning	56-62
Coining dies	56-60
Tube and section forming rools	58-62
Master hobs for cold hobbing	58-60
Swaging blocks	56-60
Guages, measuring tools, guide rails, bushes, sleeves	58-62
Dies and inserts for moulding tablets, abrasive plastics	58-62

AVAILABILITY

ASSAB XW-10 can be supplied in various finishes, including the hot-rolled, premachined and fine-machined condition. It is also available in the form of hollow bars and rings.



Comparison of fine-grained ASSAB XW-10 with high-carbon, high-chromium steel of the D3/W.-Nr. 2080 type.



PROPERTIES

PHYSICAL DATA

Hardened and tempered to 62 HRC. Data at room and elevated temperatures.

Temperature	20 °C	200 °C	400 °C
Density kg/m³	7 750	7 700	7 650
Modulus of elasticity MPa	190 000	185 000	170 000
Coefficient of thermal expansion per °C from 20 °C	-	11.6 x 10^{-6}	11.3 x 10^{-6}
Thermal conductivity W/m °C	26.0	27.0	28.5
Specific heat J/kg °C	460	-	-

COMPRESSIVE STRENGTH

Approximate values

Hardness HRC	Compressive yield strength $R_{c0.2}$ (MPa)
62	2 200
60	2 150
55	1 800
50	1 350

HEAT TREATMENT

SOFT ANNEALING

Protect the steel and heat through to 850 °C. Then cool in the furnace at 10 °C per hour to 650 °C, then freely in air.

STRESS RELIEVING

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

HARDENING

Preheating temperature: 650 – 750 °C and 850 – 900 °C.

Austenitising temperature: 925 – 970 °C, but usually 940 – 960 °C.

Temperature °C	Soaking time* min	Hardness before tempering HRC
925	40	approx. 63
950	30	approx. 64
970	20	approx. 65

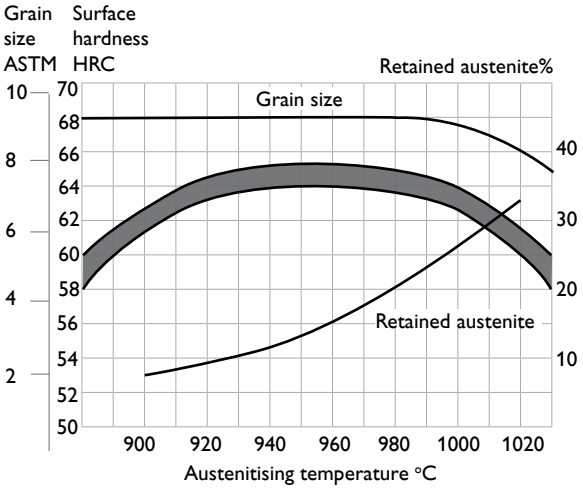
* soaking time = time at hardening temperature after the tool is fully heated through

Protect the part against decarburisation and oxidation during hardening.

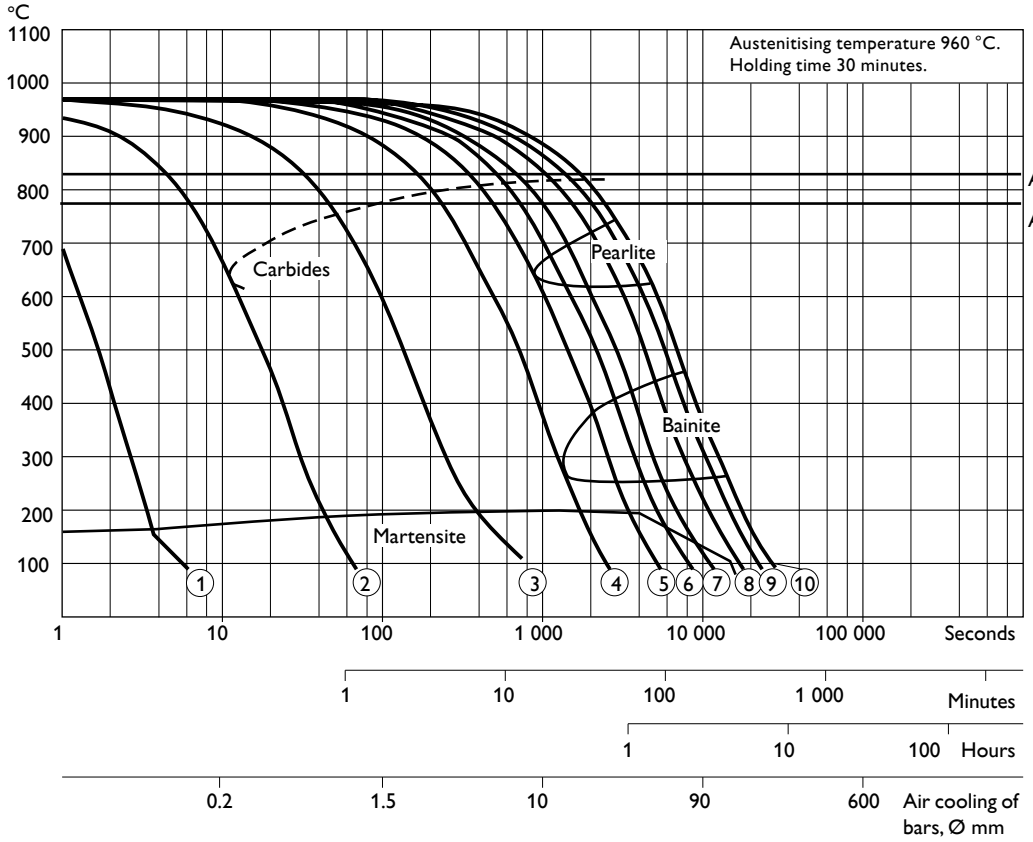
QUENCHING MEDIA

- Martempering bath or fluidised bed at 180-220°C or 450-550°C then cool in air
- Circulating air or atmposhere
- Vacuum furnace with overpressure of gas at cooling
- Oil (only for small and uncomplicated tools)

HARDNESS AS FUNCTION OF AUSTENISING TEMPERATURE



CCT GRAPH

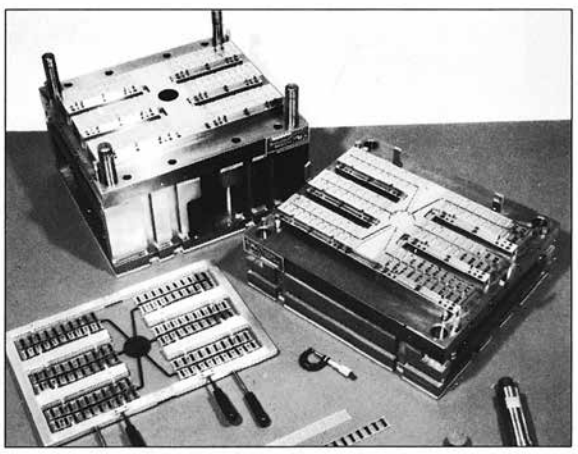


Cooling Curve No.	Hardness HV 10	$T_{800-500}$ sec
1	858	1
2	847	13
3	847	100
4	813	502
5	803	1 071
6	698	1 593
7	585	2 138
8	514	3 228
9	437	4 292
10	387	5 228

TEMPERING

Choose the tempering temperature according to the hardness required by reference to the tempering graph.

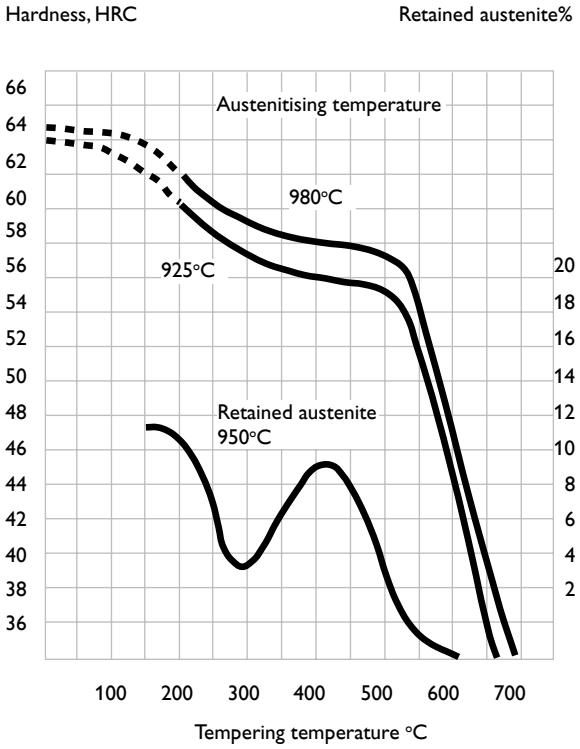
Temper twice with intermediate cooling to room temperature. Lowest tempering temperature 180°C. Holding time at temperature minimum 2 hours.



Transfer mould with ASSAB XW-10 inserts to produce encapsulated electronic components.

TEMPERING GRAPH

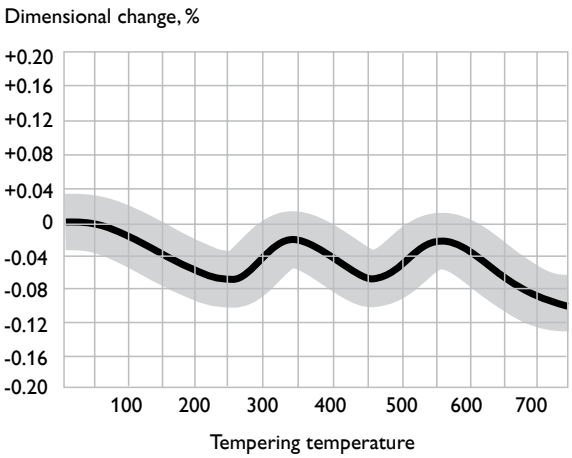
The tempering graphs are valid for small samples. The hardness received is also dependent on the tool size.



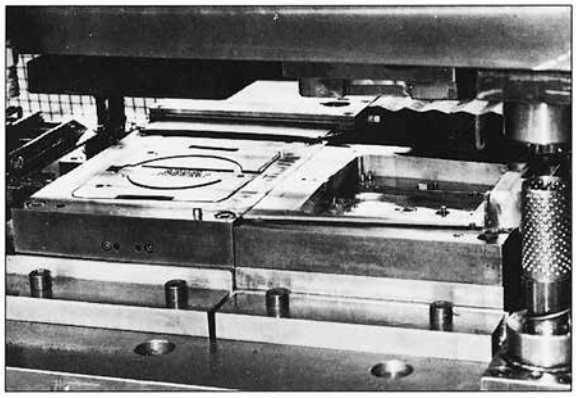
DIMENSIONAL CHANGES DURING HARDENING

Sample plate: 100 x 100 x 25 mm

		Width %	Length %	Thickness %
Oil hardened from 960°C	min	-0.08	-0.06	0
	max	-0.15	-0.16	+0.30
Martempering from 960°C	min	-0.02	-0.05	-
	max	+0.03	+0.02	+0.05
Air hardening from from 960°C	min	+0.01	-0.02	+0.08
	max	+0.02	-0.04	+0.12



Note : The dimensional changes on hardening and tempering should be added together.



This tool was made from ASSAB XW-10. 3 million parts were manufactured before the tool was reground.

SUB-ZERO TREATMENT AND AGING

Pieces requiring maximum dimensional stability should be sub-zero and/or artificially aged as volume changes may arise in the course of time. This applies, for example, to measuring tools like gauges and certain structural components.

SUB-ZERO TREATMENT

Immediately after quenching, the piece should be Sub-zero refrigerated to between -40 and -80°C (between followed by tempering or aging. Sub-zero refrigeration for 2–3 hours will give a hardness increase of 1–3 HRC. Avoid intricate shapes as there is a risk of cracking.

AGEING

Tempering after quenching is replaced by ageing at 110-140°C. Holding time 25-100 hours.

NITRIDING

Nitriding will give a hard diffused surface layer which is very resistant to wear and erosion, and also increases corrosion resistance.

Nitriding in ammonia gas at a temperature of 525°C gives a surface hardness of approx. 1000 HV_1.

Nitriding temperature °C	Nitriding time hours	Depth of case, approx mm
525	20	0.2
525	30	0.3
525	60	0.4

2 hours nitrocarburising treatment at 570°C gives a surface hardness of approx. 900 HV_1. The case depth having this hardness will be 10-20 µm.

MACHINING RECOMMENDATIONS

The cutting data below, valid for ASSAB XW-10 in soft annealed condition, are to be considered as guiding values which must be adapted to existing local conditions.

TURNING

Cutting data parameters	Turning with carbide		Turning with high speed steel
	Rough turning	Fine turning	Fine turning
Cutting speed (v_C), m/min	110 – 160	160 – 210	18 – 23
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 – 2
Carbide designation ISO	P20, P30 Coated carbide	P10 Coated carbide or cermet	–

MILLING

FACE AND SQUARE SHOULDER MILLING

Cutting data parameters	Milling with carbide	
	Rough milling	Fine milling
Cutting speed (v_C) m/min	130 – 200	200 – 240
Feed (f_z) mm/tooth	0.2 – 0.4	0.1 – 0.2
Depth of cut (a_p) mm	2 – 4	< 2
Carbide designation ISO	P20 - P40 Coated carbide	P10 – P20 Coated carbide or cermet

END MILLING

Cutting data parameters	Type of milling		
	Solid carbide	Carbide indexable insert	High speed steel
Cutting speed (v_C), m/min	80 – 120	120 – 170	15 – 20 [1]
Feed (f_z) mm/tooth	0.03 – 0.20 [2]	0.08 – 0.20 [2]	0.05 – 0.35 [2]
Carbide designation ISO	–	P20 – P40	–

1 For coated High Speed Steel end mill, v_C~ 30 – 35 m/min
2 Depending on radial depth of cut and cutter diameter

DRILLING

HIGH SPEED STEEL TWIST DRILL

Drill diameter mm	Cutting speed (v_C) m/min	Feed (f) mm/r
≤5	14 – 16*	0.05 – 0.15
5 – 10	14 – 16*	0.15 – 0.20
10 – 15	14 – 16*	0.20 – 0.25
15 – 20	14 – 16*	0.25 – 0.35

* For coated high speed steel drill, v_C = 24 – 26 m/min

CARBIDE DRILL

Cutting data parameters	Type of drill		
	Indexable insert	Solid carbide	Carbide tip [1]
Cutting speed (v_C), m/min	150 – 170	80 – 100	50 – 60
Feed (f) mm/r	0.05 – 0.15 [2]	0.10 – 0.25 [2]	0.15 – 0.25 [2]

[1] Drill with replaceable or brazed carbide tip
[2] Depnding on drill diameter

GRINDING

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

Type of grinding	Soft annealed	Hardened
Face grinding straight wheel	A 46 HV	A 46 HV
Face grinding segments	A 24 GV	A 36 GV
Cylindrical grinding	A 46 LV	A 60 KV
Internal grinding	A 46 JV	A 60 IV
Profile grinding	A 100 KV	A 120 JV

WELDING

Good results when welding tool steel can be achieved if proper precautions are taken during welding (elevated working temperature, joint preparation, choice of consumables and welding procedure). If the tool is to be polished or photoetched, it is necessary to work with an electrode type of matching composition.

Welding method	Working	Consumables	Hardeness after welding
MMA (SMAW)	200-250 °C	AWS E312	300 HB
		ESAB OK 84.52	53-54 HRC
		UTP 67S	55-58 HRC
		Castolin Eutec Trode 2	54-60 HRC
		Castolin Eutec Trode N102	54-60 HRC
TIG	200-250 °C	AWS ER312	300 HB
		UTPA 67S	55-58 HRC
		UTPA 73G2	53-56 HRC
		Casto Tig 45303W	60-64 HRC

ELECTRICAL DISCHARGE MACHINING — EDM

If EDM is performed in the hardened and tempered condition, the tool should then be given an additional temper at about 25°C below the previous tempering temperature.

Further information

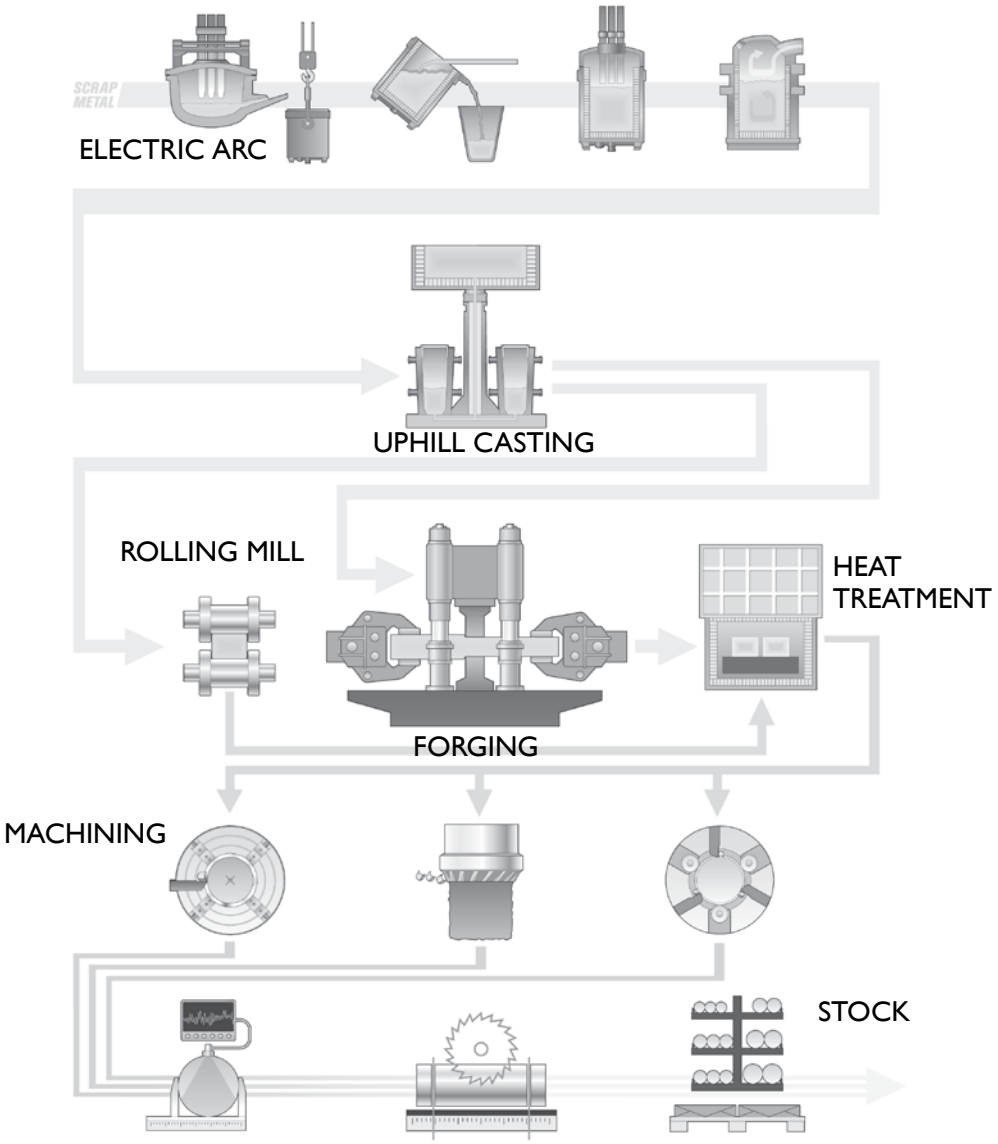
For further information, i.e., steel selection, heat treatment, application and availability, please contact our ASSAB office nearest to you.

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



THE CONVENTIONAL TOOL STEEL PROCESS

The starting material for our tool steel is carefully selected from high quality recyclable steel. Together with ferroalloys and slag formers, the recyclable steel is melted in an electric arc furnace. The molten steel is then tapped into a ladle.

The de-slagging unit removes oxygen-rich slag and after the de-oxidation, alloying and heating of the steel bath are carried out in the ladle furnace. Vacuum degassing removes elements such as hydrogen, nitrogen and sulphur.

In uphill casting the prepared moulds are filled with a controlled flow of molten steel from the ladle. From this, the steel goes directly to our rolling mill or to the forging press to be formed into round or flat bars.

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

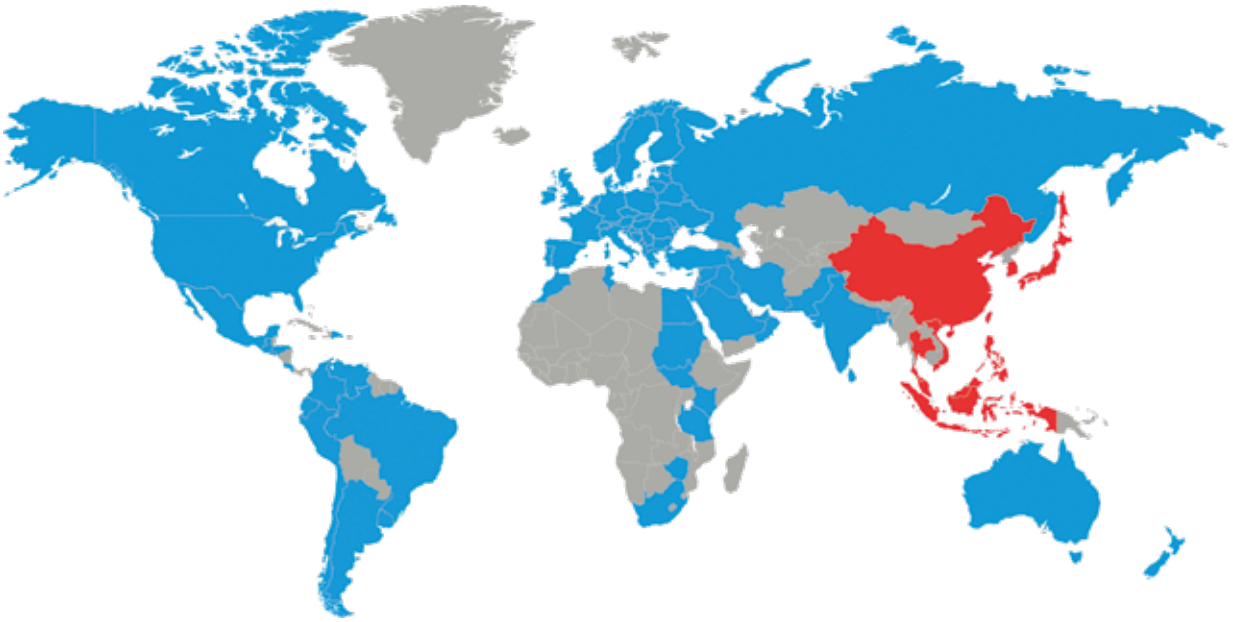
Before the material is finished and put into stock, we also rough machine the bar profiles to required size and exact tolerances.

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.

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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