since 1945
75 years

ELMAX SUPERCLEAN

UDDEHOLM ELMAX SUPERCLEAN

ASSAB

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 20200410

GENERAL

Elmax SuperClean is a high chromium-vanadium-molybdenum alloyed steel with the following characteristics:

- High wear resistance
- High compressive strength
- Corrosion resistance
- Very good dimensional stability

High wear resistance is normally associated with low corrosion resistance and vice versa. In Elmax SuperClean, however, this unique combination of good corrosion resistance and high abrasive wear resistance is achieved by SuperClean powder metallurgical process and its unique chemistry.

Elmax SuperClean offers a possibility to make long-life, low-maintenance moulds for the best overall moulding economy.

Typical analysis %	C 1.7	Si 0.8	Mn 0.3	Cr 18.0	Mo 1.0	V 3.0
Delivery condition	Soft annealed approx. 280 HB					

APPLICATIONS

New types of engineering plastics, with high filler contents, place greater demands on the tooling material, in terms of wear resistance and corrosion resistance. Elmax SuperClean has been specially developed for high-tech applications. These include products within the electronic industry such as connectors, plugs, switches, resistors, integrated circuits, etc. Elmax SuperClean can also be used in the food processing industry and for industrial and custom knives, where a combination of corrosion resistance and wear resistance is required.

Elmax SuperClean used in Kershaw's knife Speedform, awarded "Blade Magazine 2009 American-Made Knife Of The Year".

PROPERTIES

PHYSICAL DATA

Hardened and tempered to 58 Rockwell C.

Temperature	20 °C	200 °C	400 °C
Density kg/m^3	7 600	7 560	7 500
Modulus of elasticity N/mm^2	230 000	210 000	200 000
Coefficient of thermal expansion /°C from 20°C	-	10.6 x 10^{-6}	11.4 x 10^{-6}
Thermal conductivity* W/m °C	-	15	21
Specific heat capacity J/kg °C	460	-	-

* Thermal conductivity is difficult to measure. The scatter may be as high as ±15%

COMPRESSIVE STRENGTH

Hardness	60 HRC	55 HRC	50 HRC
Compressive strength, Rm N/mm^3	3 000	2 700	2 300
Yield point, $Rp_{0.2}$ N/mm^2	2 300	2 150	1 800

CORROSION RESISTANCE

Moulds made from Elmax SuperClean will have good resistance to corrosion when moulding corrosive plastics under normal production conditions.

HEAT TREATMENT

SOFT ANNEALING

Protect the steel and heat through to 980°C, holding time 2 hours. Then cool in furnace 20°C/h to 850°C. Holding time 10 hours. Cool slowly to 750°C. Then freely in air.

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

Preheating temperature: 600–850°C.
Austenitising temperature: 1050–1100°C,
normally 1080°C.

Temperature °C	Holding time * minutes	Hardness before tempering HRC
1050	30	60
1080	30	61

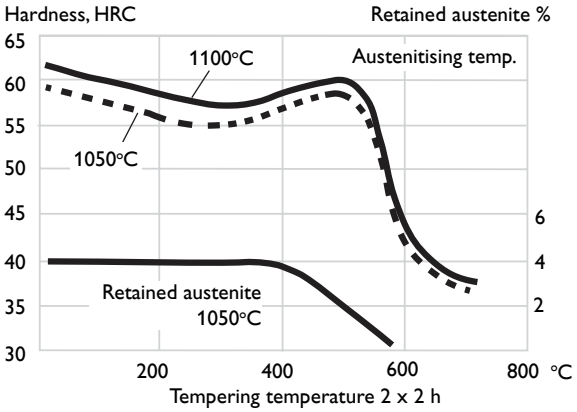
* Holding time = time at austenitising temperature after the tool is fully heated through

Protect the part against decarburisation and oxidation during hardening.

TEMPERING

Choose the tempering temperature according to the hardness required by reference to the tempering graph. Temper twice with intermediate cooling to room temperature, the preferred tempering temperature is 250°C or higher. In exceptional cases, a minimum tempering temperature of 180°C can be used for small simple inserts and parts where toughness is of less importance. Holding time at tempering temperature minimum 2 hours.

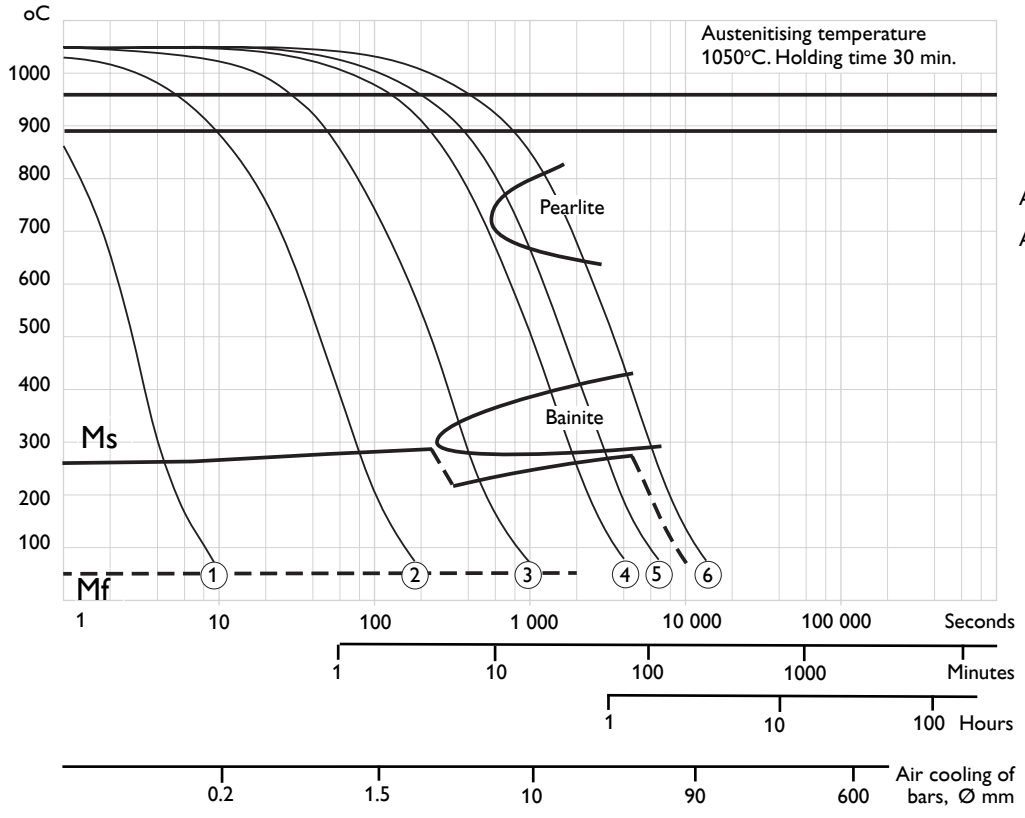
TEMPERING GRAPH



Above 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.

CCT-GRAPH

Austenitising temperature 1050 °C. Holding time 30 minutes.



A_{C1} = 960 °C

A_{Cs} = 890 °C

Cooling Curve No.	Hardness HV 10	$T_{800-500}$ sec
1	792	1
2	782	28
3	690	140
4	665	630
5	542	1030
6	360	2095

QUENCHING MEDIA

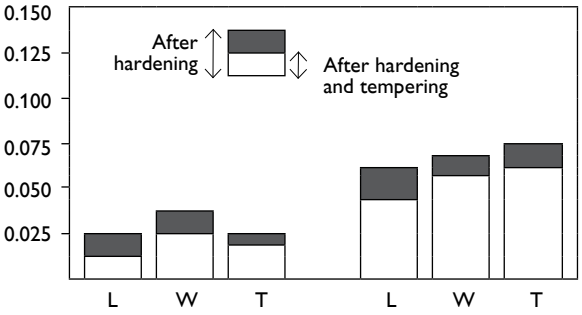
- Forced air/gas
- Fluidised bed or salt bath 200 - 550 °C, then cool in air.

Note : In order to obtain optimum properties, the cooling rate should be as fast as is concomitant with acceptable distortion. Temper immediately the tool reaches 50–70°C.

DIMENSIONAL CHANGES DURING HEAT TREATMENT

ILLUSTRATION OF THE EFFECT FROM AUSTENITISING TEMPERATURE AND SUBZERO COOLING

The test has been performed on sample size:
40 x 40 x 40 mm



Austenitising	1050°C / 30 min	1050°C / 30 min
Qeunching medium	air	air
Sub-zero treament	-	-60°C
Tempering	230°C / 2h + 2 h	230°C / 2h + 2 h

SUB-ZERO TREATMENT

Sub-zero treatment falls into the broad categories of cold treatment and cryogenic treatment. Parts requiring high dimensional stability should be sub-zero treated, otherwise volume changes may arise.

Elmax SuperClean is commonly sub-zero treated between -150°C and -196°C (cryo treatment), although occasionally -40°C to -80°C (cold treatment) are used due to constraints of the sub-zero medium and equipment available.

The first sub-zero treatment should be carried out directly after hardening and before any tempering without delay. When maximum dimensional stability is required further subzero treatments may be necessary between the tempering operations. In this case it is important to always end with a tempering, as the last operation.

1–3 hours treatment results in an increased hardness of about 1–3 HRC.

Note: Avoid intricate shapes as there is a risk of cracking.

MACHINING RECOMMENDATIONS

The machining recommendations below 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 Fine turning
	Rough turning	Fine turning	
Cutting speed (v_c), m/min	70 - 120	120 - 140	10 - 14
Feed (f) mm/rev	0.2 - 0.4	0.05 - 0.2	0.05 - 0.2
Depth of cut (a_p) mm	2 - 4	0.5 - 2	0.5 - 3
Carbide designation ISO	K20, P10– P20 Coated carbide*	K15, P10 Coated carbide*	-

* Use a wear resistant Al_2O_3 coated carbide grade

DRILLING

HIGH SPEED STEEL TWIST DRILL

Drill diameter mm	Cutting speed (v_c) m/min	Feed (f) mm/r
≤ 5	10 - 12*	0.05 – 0.15
5 – 10	10 - 12*	0.15 – 0.20
10 – 15	10 - 12*	0.20 – 0.25
15 – 20	10 - 12*	0.25 – 0.35

* For coated high speed steel drills V_c = 18–20 m/min.

CARBIDE DRILL

Cutting data parameters	Type of drill		
	Indexable insert	Solid carbide	Carbide tip[1]
Cutting speed (vc), m/min	90 - 120	60 - 80	30 - 35
Feed (f) mm/r	0.05 – 0.25 [2]	0.10 – 0.25 [2]	0.15 – 0.25 [2]

[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

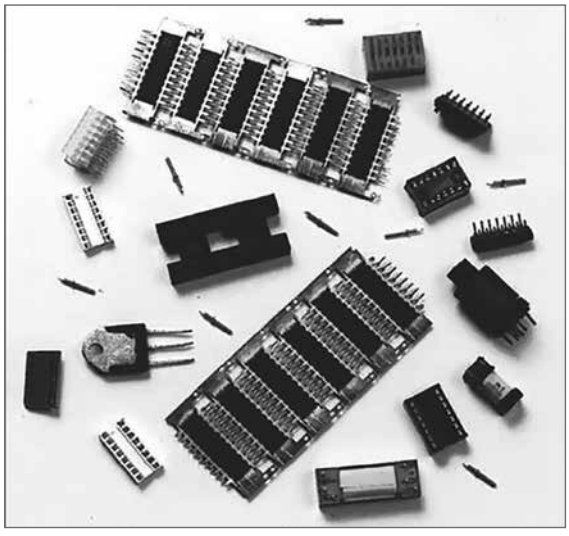
Cutting data parameters	Milling with carbide	
	Rough milling	Fine milling
Cutting speed (v_c) m/min	80 – 110	110 – 140
Feed (f_z) mm/tooth	0.2 – 0.4	0.1 – 0.2
Depth of cut (a_p) mm	2 – 4	≤ 2
Carbide designation ISO	K20, P20 Coated carbide*	K15, P10 Coated carbide*

* Use a wear resistant Al_2O_3 coated carbide grade

END MILLING

Cutting data parameters	Type of end mill		
	Solid carbide	Carbide indexable insert	High speed steel
Cutting speed (v_c), m/min	50 – 60	80 – 110	5 – 8 [1]
Feed (f_z) mm/tooth	0.01 - 0.20 [2]	0.06 – 0.20 [2]	0.01 – 0.30 [2]
Carbide designation ISO	- Coated [3] carbide	K15, P10 – P20 Coated carbide	–

[1] For coated high speed steel end mill Vc = 14 –16 m/min
[2] Depending on radial depth of cut and cutter diameter
[3] Use a wear resistant Al_2O_3 coated carbide grade



Different parts produced in tools made from Elmax SuperClean.

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 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

* If possible use CBN wheels for this application

ELECTRICAL DISCHARGE MACHINING — EDM

If EDM’ing (“spark-erosion”) is performed in the hardened and tempered condition, the tool should then be given an additional temper at about 20°C below the previous tempering temperature.

PROPERTY COMPARISON CHART

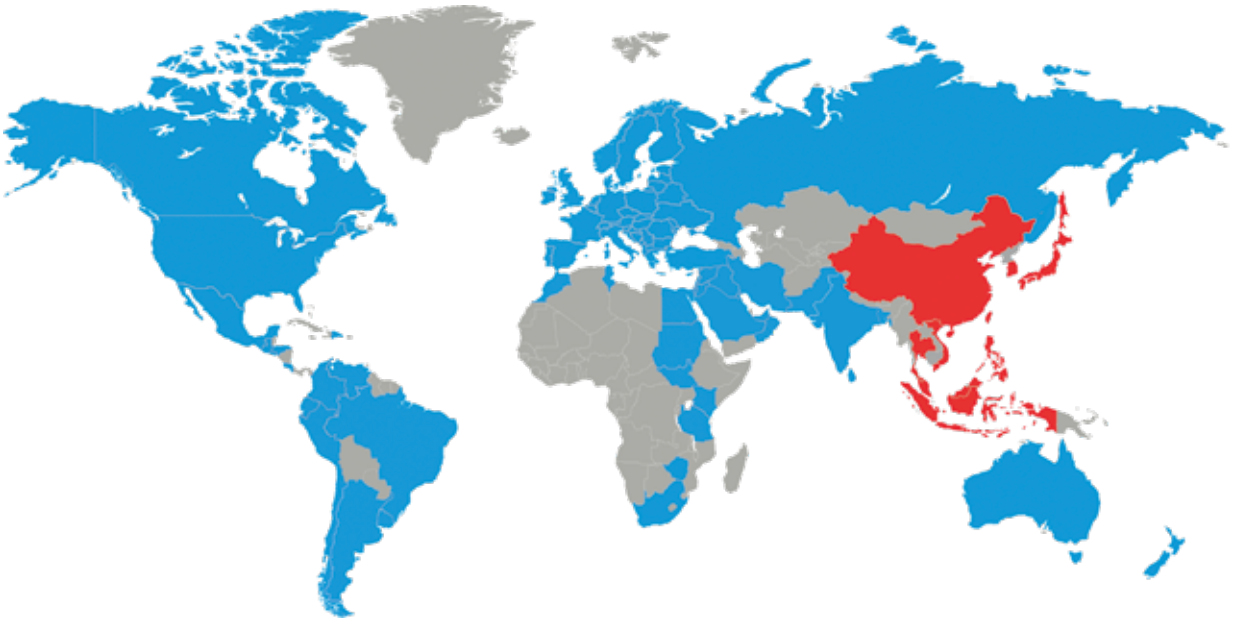
ASSAB grade	Wear resistance	Corrosion resistance	Dimensional stability
Elmax SuperClean			
ASSAB XW-10			
Stavax ESR			

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

UDDEHOLM
a voestalpine company

ASSAB