since 1945
75 years

POLMAX

UDDEHOLM POLMAX

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 20200520

GENERAL

The rapid development in the high tech area is putting higher and higher demands on the tool steel. Surface finishes, which have not been possible to achieve with ordinary tool steel, are required. For these extreme requirement Polmax is the right choice. For Polmax, methods like ESR (Electro Slag Remelting) and VAR (Vacuum Arc Remelting) are used in order to reduce inclusion levels to minimum amounts.
Characteristics found in Polmax:

- Excellent polishability
- Good corrosion resistance
- Good wear resistance
- Good machinability
- Good stability in hardening

Typical analysis %	C 0.38	Si 0.9	Mn 0.5	Cr 13.6	V 0.3
Delivery condition	Soft annealed to approx. 200 HB				

APPLICATIONS

Examples on applications where extreme surface finishes are required:

- Lens moulds
- Moulds for medical applications
- Moulds for optical applications
- Moulds for analysis phials

PROPERTIES

PHYSICAL PROPERTIES

Hardened and tempered to 52 HRC. Data at room and elevated temperatures.

Temperature	20 °C	200 °C	400 °C
Density kg/m^3	7 800	7 750	7 700
Modulus of elasticity MPa	200 000	190 000	180 000
Coefficient of thermal expansion /°C from 20 °C	-	11.0 x 10^{-6}	11.4 x 10^{-6}
Thermal conductivity W/m°C	16	20	24
Specific heat J/kg°C	460	-	-

STRENGTH OF MATERIAL

The strength vlaues are to be considered as approximate. The test samples have been hardened in oil from 1025°C and tempered twice to 52 HRC.

Tensile strength, Rm, N/mm^2	2 050
Yield point, Rp0.2, N/mm^2	1 610

CORROSION RESISTANCE

Polmax is resistant to corrosive attack by water, water vapour, weak organic acids, dilute solutions of nitrates, carbonates and other salts.
A tool made from Polmax will have good resistance to rusting and staining due to humid working and storage conditions and when moulding corrosive plastics under normal production conditions.
Polmax shows the best corrosion resistance when tempered at 250°C and polished to a mirror finish.

HEAT TREATMENT

SOFT ANNEALING

Protect the steel and heat through to 890 °C. Then cool in furnace at 20°C per hour to 850 °C, then at 10°C per hour to 700°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 : 1000 – 1500°C but usually 1020 - 1030°C

Temperature, °C	Soaking time * minutes	Hardness before tempering, HRC
1 020	30	56 ± 2
1 050	30	57 ± 2

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

Protect the part against decarburisation and oxidation during hardening.

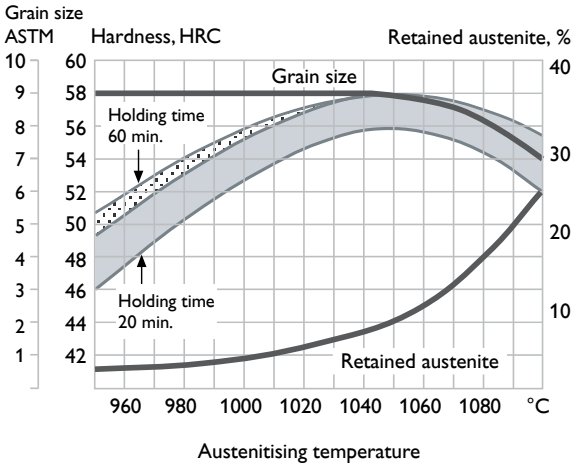
QUENCHING

QUENCHING MEDIA

- Fluidised bed or salt bath at 250-550 °C then cool in air blast
- Vacuum with sufficient positive pressure
- High speed gas/circulating atmosphere

In order to obtain optimum properties, the cooling rate should be as fast as is concomitant with acceptable distortion. When heat treating in a vacuum furnace, a 4-5 bar overpressure is recommended. Temper immediately when the tool reaches 50-70 °C.

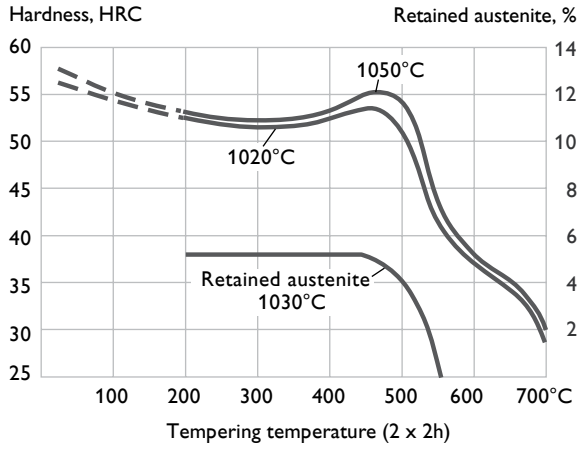
HARDNESS, GRAIN SIZE AND RETAINED AUSTENITE AS FUNCTIONS OF AUSTENITISING TEMPERATURE



TEMPERING

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

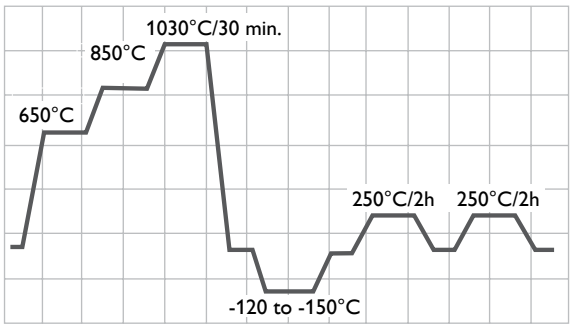
Temper twice with intermediate cooling to room temperature. Lowest tempering temperature 180°C. Holding time at temperature minimum 2 hours.



Note that:

- Tempering at 250°C is recommended for the best combination of toughness, hardness and corrosion resistance.
- Above curves are valid for small samples, achieved hardness depends on mould size
- A combination of high austenitising temperature and low tempering temperature <250°C gives a high stress level in the mould and should be avoided.

For maximum hardness and best combination of toughess, corrosion resistance and dimension stability during use, following heat treatment cycle is recommended.

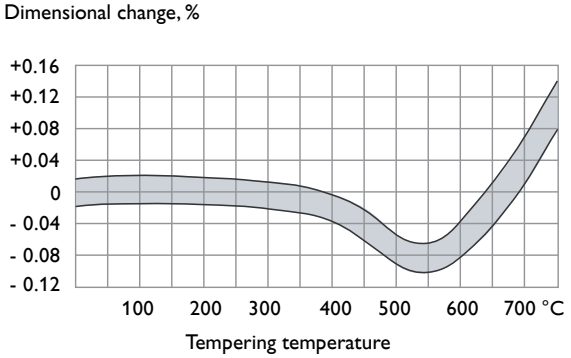


Subzero cooling is only required when demands on dimension stability during use are very high. Received hardness: 52-54 HRC.

DIMENSIONAL CHANGES

The dimensional changes during hardening and tempering vary depending on temperatures, type of equipment and cooling media used during heat treatment.

The size and geometric share of the tool is also of essential importance. Thus, the tool shall always be manufactured with enough working allowance to compensate for dimensional changes. Use 0.15% as a guideline for Polmax provided that a stress relief is performed between rough and semi-finished machining as recommended.



DURING HARDENING

An example of dimensional changes on a plate, hardened under ideal conditions 100 x 100 x 25 mm is shown below.

Hardening from 1020°C		Width %	Length %	Thickness %
Martempered	Min. Max.	+0.02 -0.03	±0 +0.03	-0.04 -
Air hardened	Min. Max.	-0.02 +0.02	±0 -0.03	±0 -
Vacuum hardened	Min. Max.	+0.01 -0.02	±0 +0.01	-0.04 -

Note: Dimensional changes during hardening and tempering should be added together.

MACHINING RECOMMENDATIONS

TURNING

Cutting data parameters	Turning with carbide		Turning with High speed steel Fine turning
	Rough turning	Fine turning	
Cutting speed (v_C), m/min	160 – 210	210 – 260	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 - 3
Carbide designation ISO	P20 - P30 Coated carbide	P10 Coated carbide or cermet	-

DRILLING

HIGH SPEED STEEL TWIST DRILL

Drill diameter mm	Cutting speed (v_C) m/min	Feed (f) mm/r
≤ 5	12 – 14 *	0.05 – 0.10
5 – 10	12 – 14 *	0.10 – 0.20
10 – 15	12 – 14 *	0.20 – 0.30
15 – 20	12 – 14 *	0.30 – 0.35

* For coated HSS drill v_c = 20 - 22 m/min.

CARBIDE DRILL

Cutting data parameters	Type of drill		
	Indexable insert	Solid carbide	Carbide tip [1]
Cutting speed (v_C), m/min	210 – 230	80 – 100	70 – 80
Feed (f) mm/r	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 parameters	Milling with carbide	
	Rough milling	Fine milling
Cutting speed (v_C) m/min	180 – 260	260 – 300
Feed (f_z) mm/tooth	0.2 – 0.4	0.1 – 0.2
Depth of cut (a_p) mm	2 – 4	0.5 - 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	120 – 150	170 – 230	25 – 30 [1]
Feed (f_z) mm/tooth	0.01 – 0.20 [2]	0.06 – 0.20 [2]	0.01 – 0.30 [2]
Carbide designation ISO	–	P20 – P30	–

[1] For coated HSS end mill, vc ~ 45 – 50 m/min
[2] Depending on radial depth of cut and cutter diameter

GRINDING

WHEEL RECOMMENDATION

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

POLISHING

Polmax has extremely good polishability in the hardened and tempered condition.

A slightly different technique is needed when polishing corrosion resistant tool steel compared with conventional tool steel. The main principle is to use smaller steps at the fine grinding/polishing stages and try to grind to as fine surface as possible before starting the polishing operation. It is also important to stop the polishing operation immediately the last scratch from the former grain size has been removed.

PRACTICAL HINTS

- Polishing should be carried out in dust and draught free places. Hard dust particles can easily contaminate the abrasive and ruin an almost finished surface.
- Each polishing tool should be used for only one paste grade and kept in dust-proof container.
- The polishing tools gradually become "impregnated" and improve with use.
- Hands and work piece should be cleaned carefully between each change of paste grade, the work-piece with a grease solvent and the hands with soap.
- Paste should be applied to the polishing tool in manual polishing, while in machine polishing, the paste should be applied to the work-piece.
- The finer the grain size, the less thinning liquid
- Polishing pressure should be adjusted to the hardness of the polishing tool and the grade of the paste. For the finest grain sizes, the pressure should only be the weight of the polishing tool.
- Heavy material removal requires hard polishing tools and coarse paste.
- Finish polishing of plastic moulds should be carried out in the release direction.
- Polishing should start in the corners, edges and fillets or the difficult parts of the mould.
- Be careful with sharp corners and edges, so they are not rounded off. Preferably use hard polishing tools.

Cleanliness in every step of the polishing operation is of such great importance that it can not be over emphasized.

PHOTO-ETCHING

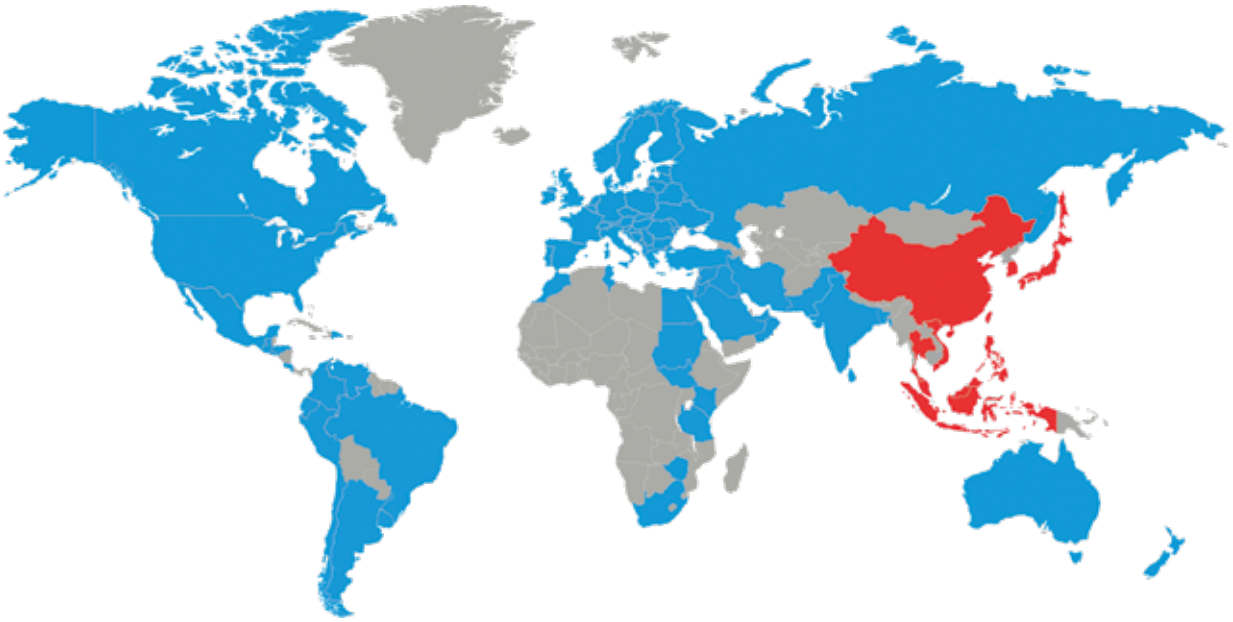
Polmax has a very low content of slag inclusions, making it suitable for photo-etching.
The special photo-etching process that might be necessary because of Polmax's good corrosion resistance is familiar to all the leading photo-etching companies.

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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