MIRRAX 40

UDDEHOLM MIRRAX 40

ASSAB	UDDEHOLM a voestalpine company	REFERENCE STANDARD		
		AISI	WNr.	JIS
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 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			

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( ) - modified grade

Edition 20220921

GENERAL

Mirrax 40 is a remelted stainless tool steel supplied prehardened to 40 HRC.

Mirrax 40 is produced using the electroslag remelting (ESR) process – an additional step in the steel making process that ensures very clean steel with low sulphur content (0.003% max.) and non-metallic inclusions. Consequently, Mirrax 40 is capable of being polished to a very high surface finish.

Mirrax 40 is characterised by:

- Excellent machinability
- Excellent polishability
- Excellent ductility and toughness
- Uniform hardness even in large dimensions
- Good indentation resistance
- Good corrosion resistance

These properties combine to give a steel with outstanding production performance.

The practical benefits of good corrosion resistance can be summarised as follows:

- Lower mould maintenance costs.
  The surface of cavity impressions retain their original finish over an extended service life.
  Moulds stored or operated in humid conditions require no special protection.
- Lower production costs.
  Since cooling channels are less likely to be affected by corrosion (unlike conventional mould steel), heat transfer characteristics, and therefore cooling efficiency, are constant throughout the mould life, ensuring consistent cycle times.

The benefit of the prehardened condition can be summarised as follows:

- No hardening risks
- No hardening costs
- Time saving, e.g. no waiting for heat treatment
- Lower tool cost (e.g. no distortion to rectify)
- Modifications easily carried out

In addition, the combination of high hardness with a high toughness results in a mould with good resistance to indentations and minimise the risk of unexpected failures, leading to a safer mould and a prolonged tool life.

Typical analysis %	C 0.21	Si 0.9	Mn 0.45	Cr 13.5	Mo 0.2	Ni 0.6	V 0.25	+N
Standard specification	AISI 420 modified							
Delivery condition	Prehardened to approx. 360 - 400 HB.							

APPLICATIONS

- Injection moulds for corrosive and non corrosive plastics
- Plastic moulding of high surface finish products (e.g. Bezels and casings for TV and computers)
- Blow moulding of corrosive plastics or high surface finish transparent products (e.g. PET bottles)
- Extrusion dies
- Constructional parts

PROPERTIES

PHYSICAL DATA

Hardened and tempered to 360 HB. Data at room and elevated temperatures.

Temperature	20 °C	200 °C	400 °C
Density, kg/m^3	7 700	-	-
Modulus of elasticity N/mm^2	215 000	210 000	195 000
Coefficient of thermal expansion /°C from 20°C	-	10.6 x 10^{-6}	11.4 x 10^{-6}
Thermal conductivity* W/m °C	-	20	21
Specific heat J/kg °C	460	-	-

MECHANICAL DATA

TENSILE STRENGTH

All specimens have been taken from a bar with the dimension 508 x 306 mm, hardness 360 HB.

Testing temperature	20 °C	200 °C
Tensile strength, R_m MPa	1 150	1 060
Yield point Rp0.2 MPa	1 020	930
Reduction of area, Z %	35	38
Elongation , A5 %	13	11

COMPRESSIVE STRENGTH

Compressive yield strength at room temperature Rc0.2, N/mm^2	1 100

CORROSION RESISTANCE

Moulds made from Mirrax 40 will have good resistance to rusting caused by humid working and storage conditions and when moulding corrosive plastics under normal production conditions.

HEAT TREATMENT

Mirrax 40 is intended for use in the as-delivered condition i.e. hardened and tempered to 360 – 400 HB. When the steel is to be heat treated to higher hardness, instructions below are to be followed.

SOFT ANNEALING

Protect the steel and heat through to 780 °C. Cool at 10 °C per hour to 600 °C, then freely in air.

STRESS RELIEVING

After rough machining the tool should be heated through to max. 550 °C, holding time 2 hours, then cool freely in air.

HARDENING

Note: It is recommended to do soft annealing before hardening.

Preheating temperature: 500 – 600 °C.

Austenitising temperature: 1000 – 1025 °C but usually 1020 °C.

The steel should be heated through to the austenitising temperature and held at temperature for 30 minutes.

Protect the tool against decarburisation and oxidation during the hardening process.

QUENCHING MEDIA

- Vacuum with sufficient positive pressure
- High speed gas / circulating atmosphere

In order to obtain the optimum properties, the cooling rate should be as fast as possible within acceptable distortion limits. Temper the tool as soon as its temperature reaches 50 - 70 °C during the hardening process.

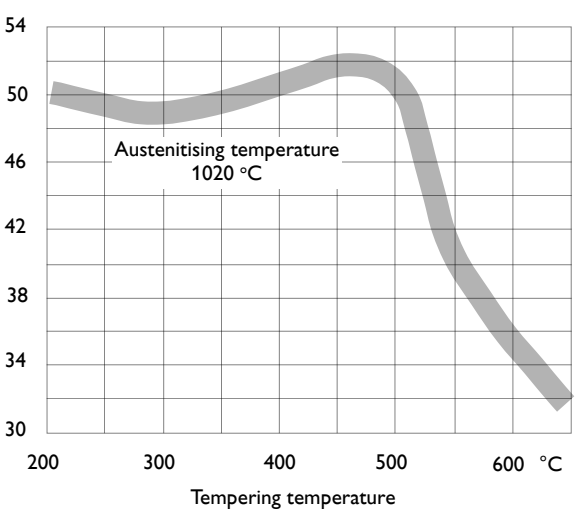
TEMPERING

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

Lowest tempering temperature 250°C. Holding time at temperature minimum 2 hours.

TEMPERING GRAPH

The tempering curve is approximate.



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.

MACHINING RECOMMENDATIONS

The cutting data below are to be considered as guidelines and may require adjustments based on equipment, selection of cutting tools, etc.

The recommendations, in following tables, are valid for Mirrax 40 hardness approx. 380 HB.

TURNING

Cutting data parameters	Turning with carbide		Turning with high speed steel
	Rough turning	Fine turning	Fine turning
Cutting speed (v_C), m/min	80 – 130	130 – 180	10 – 15
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	–

MILLING

FACE AND SQUARE SHOULDER MILLING

Cutting data parameters	Milling with carbide	
	Rough milling	Fine milling
Cutting speed (v_C) m/min	80 – 120	120 – 150
Feed (f_z) mm/tooth	0.2 – 0.4	0.1 – 0.2
Depth of cut (a_p) mm	2 – 5	≤ 2
Carbide designation ISO	P20 - P40 Coated carbide	P10 – P20 Coated carbide or cermet

END MILLING

Cutting data parameters	Type of end mill		
	Solid carbide	Carbide indexable insert	High speed steel
Cutting speed (v_C), m/min	60 – 100	80 – 120	20 – 25 [1]
Feed (f_z) mm/tooth	0.03 – 0.20 [2]	0.08 – 0.20 [2]	0.05 – 0.35 [2]
Carbide designation ISO	–	P15 – P40	–

[1] For coated HSS end mill v_c = 25 – 30 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	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 – 0.30

* For coated HSS drill v_c = 16 – 18 m/min.

CARBIDE DRILL

Cutting data parameters	Type of drill		
	Indexable insert	Solid carbide	Carbide tip [1]
Cutting speed (vc), m/min	100 – 120	80 – 100	70 – 80
Feed (f) mm/r	0.05 – 0.25 [2]	0.10 – 0.25 [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

GRINDING

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

Type of grinding	Delivery condition
Face grinding straight wheel	A 46 HV
Face grinding segments	A 36 GV
Cylindrical grinding	A 60 KV
Internal grinding	A 60 JV
Profile grinding	A 120 JV

WELDING

Good results when welding tool steel can be achieved if proper techniques are used. Precautions such as preheating, heat treatment, post weld heat treatment, joint preparation, selection of consumables, etc. are required.

For best result after polishing and photo-etching use consumables with a matching chemical composition to the mould steel.

Welding method	TIG
Working temperature	200 - 250 °C
Welding consumables	MIRRAX TIG Weld
Hardness after welding	54 - 56 HRC
Heat treatment* after welding tempering 38 - 42 HRC.	Temper at 560 °C, 2 h. Weld metal hardness after

* Post treatment is recommended to reduce the risk of cracking and to achieve an even hardness profile.

POLISHING

Mirrax 40 has a very good polishability in the hardened and tempered condition.

A slightly different technique, in comparison with other ASSAB mould steel, should be used. The main principle is to use smaller steps at the fine-grinding/ polishing stages and not to start polishing on too rough of a surface.

It is also important to stop the polishing operation immediately after the last scratch from the former grit size has been removed.

PHOTO-ETCHING

Mirrax 40 has a very low inclusion content and a homogeneous microstructure.

The high cleanliness level provides for good photo-etching/texturing characteristics.

The special photo-etching process that might be necessary because of Mirrax 40's good corrosion resistance is familiar to all the leading photo-etching companies.

ELECTRICAL DISCHARGE MACHINING — EDM

If spark-erosion, EDM, is performed in the as delivered condition, the tool should then be given an additional temper at approx. 550 °C.

If the steel has been rehardened, the additional tempering temperature should be 25 °C lower than the last tempering temperature used.

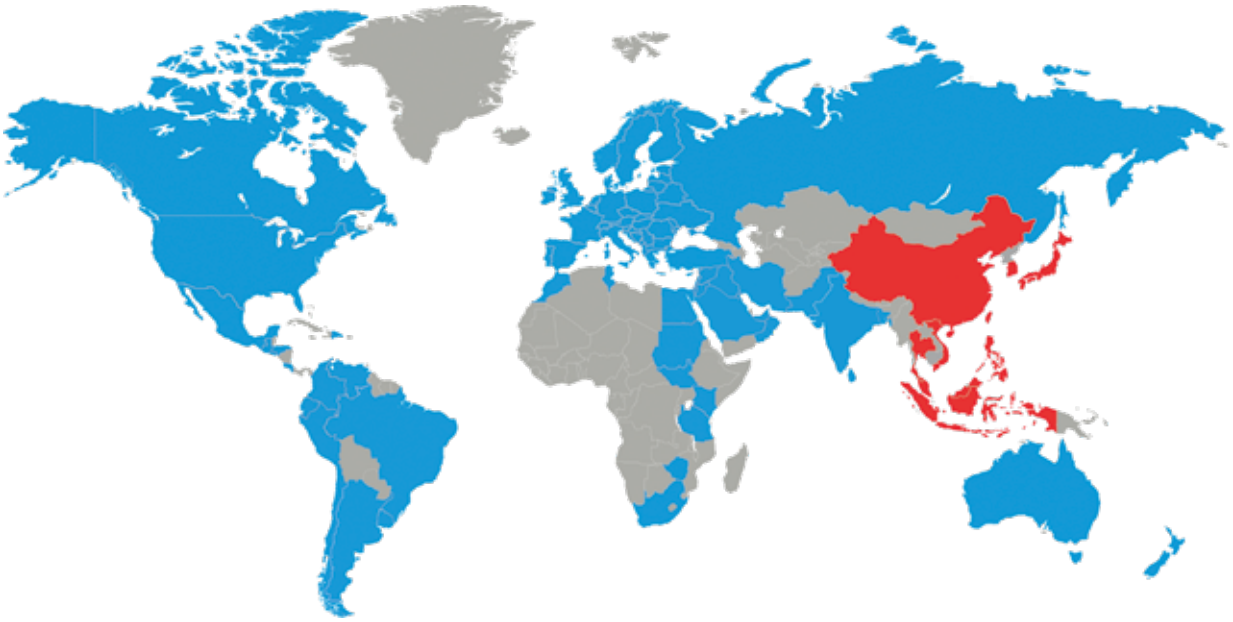
However, the best is to remove the affected layer completely by polishing or stoning.

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 most suitable treatment for each application. ASSAB not only supplies steel products with superior quality, but we also offer state-of-the-art machining, heat treatment, surface treatment services and additive manufacturing (3D printing) to enhance your tooling performance while meeting your requirements in the shortest lead time. Using a holistic approach as a one-stop solution provider, we are more than just another tool steel supplier.

In Asia Pacific, ASSAB anchors the distribution network for Uddeholm, a Swedish tool steel manufacturer with more than 350 years of experience in the tool steel industry. The two companies together service leading multinational companies (MNCs) in more than 90 countries.

For more information, please visit
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