VIDAR SUPERIOR

UDDEHOLM VIDAR SUPERIOR

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
VIDAR SUPERIOR	VIDAR SUPERIOR	(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 20240913

VIDAR SUPERIOR

Vidar Superior belongs to the new generation of modified H11 (1.2343) steel grades with a low silicon content. The steel is produced using the very latest in production techniques and shows very high toughness values.

Vidar Superior is tested and certified, providing the customer the best possible performance. Suitable applications are those where a High toughness is needed; like in die casting or forging. The high purity in Vidar Superior makes it an excellent steel also in plastic applications.

IMPROVED TOOLING PERFORMANCE

The name “Superior” implies that by special processing techniques and close process control, the steel attains high purity and a very fine structure. Vidar Superior shows significant improvements in impact toughness compared to material of the H11 (W.-Nr. 1.2343) type.

The improved impact toughness is particularly valuable for tooling subjected to high mechanical and thermal stresses, e.g. die casting dies and forging tools. In practical terms, tools may be used at Somewhat higher working hardness (2 HRC) without loss of toughness. Since increased service hardness limits the formation of thermal fatigue cracks, improved tool performance can be expected.

GENERAL

Vidar Superior is a chromium-molybdenum-vanadium alloyed hot work tool steel which is characterised by:

- High level of resistance to thermal shock and thermal fatigue
- Good high-temperature strength
- Excellent toughness and ductility in all directions
- Excellent through-hardening properties
- Good dimensional stability during hardening

Typical analysis %	C 0.36	Si 0.3	Mn 0.3	Cr 5.0	Mo 1.3	V 0.5
Standard specification	X36 CrMoV5 (CNOMO) X36 CrMoV5-1, W.-Nr. 1.2340 ~AISI H11, ~B H11, ~W.-Nr. 1.2343, ~AFNOR Z38 CDV 5, ~UNI X37 CrMoV 51 KU, ~UNE X37 CrMoV 5					
Delivery condition	Soft annealed to approx. 180 HB					

APPLICATIONS

TOOLS FOR DIE CASTING

Part	Tin, lead, zinc alloys, HRC	Aluminium, Magnesium alloys, HRC
Dies	46-50	42-48
Fixed inserts, cores	48-52	46-50
Sprue parts	(ASSAB 8407)	(ASSAB 8407)
Nozzles	(ASSAB 8407)	(ASSAB 8407)
Ejector pins (nitrided)	(ASSAB 8407)	(ASSAB 8407)
Plunger, shot-sleeve (normally nitrided)	(ASSAB 8407)	(ASSAB 8407)
Austenitising temperature	980-1000°C	

TOOLS FOR HOT FORGING

Material	Austenitising temperature (approx.)	HRC
Aluminium, magnesium Copper alloys steel	980 - 1000 °C	44 - 52
	980 - 1000 °C	44 - 52
	980 - 1000 °C	40 -50

MOULDS FOR PLASTICS

Part	Austenitising temperature (approx.)	HRC
Injection moulds compression / transfer moulds	980 - 1000 °C	46 - 52

PROPERTIES

PHYSICAL DATA

All specimens are taken from the centre of a 1000 x 200 mm bar. Unless otherwise is indicated all specimens were hardened from 1000°C, quenched in a vacuum furnace and tempered 2 + 2h at 600°C to 45 ±1 HRC.

Temperature	20 °C	200 °C	400 °C	600 °C
Density kg/m^3	7 800	7 750	7 700	7 600
Modulus of elasticity MPa	210 000	200 000	180 000	140 000
Coefficient of thermal expansion - per °C from 20 °C	-	11.6×10^{-6}	12.4×10^{-6}	13.2×10^{-6}
Thermal conductivity W/m °C	-	30	30	31

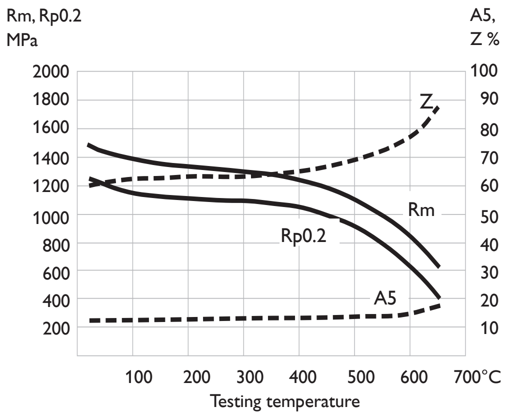
MECHANICAL PROPERTIES

Approximate tensile strength at room temperature

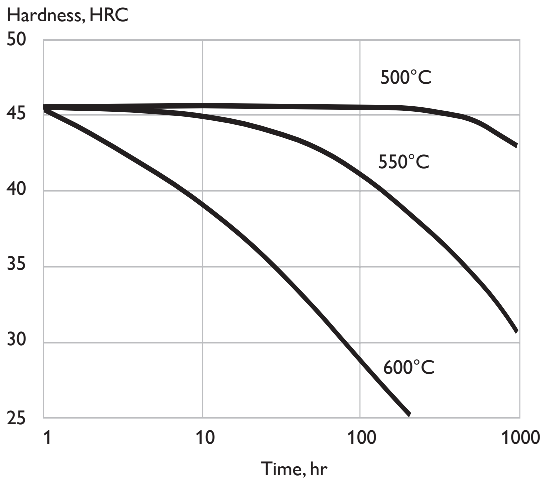
Hardness	45 HRC	46.5 HRC	48.5 HRC
Tensile strength R_m, MPa	1 450	1 580	1 680
Yield strength R_p 0.2, MPa	1 240	1 340	1 410
Elongation A_5, %	13	13	12
Reduction in area Z, %	65	65	64

APPROXIMATE STRENGTH AT ELEVATED TEMPERATURES

Longitudinal direction

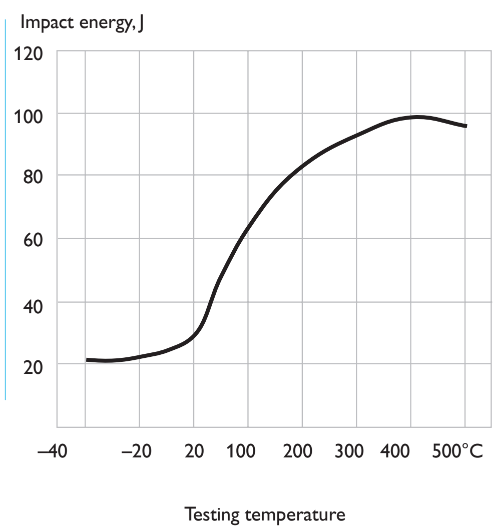


EFFECT OF TIME AT HIGH TEMPERATURES ON HARDNESS



EFFECT OF TESTING TEMPERATURES ON IMPACT ENERGY

Charpy V specimens, short transverse direction.



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 holding time 2 hours. Cool slowly to 500 °C, then freely in air.

HARDENING

Preheating temperature: 600 – 900 °C. Minimum two preheating steps at 600-650 °C and 820-850°C. When three preheats are used the second is carried out at 820 °C and the third at 900 °C

Austenitising temperature: 980 – 1010 °C.

Soaking time: 30 - 45 minutes

Soaking time = time at austenitising temperature after the tool is fully heated through.

Protect the tool against decarburisation and oxidation during austenitising.

QUENCHING MEDIA

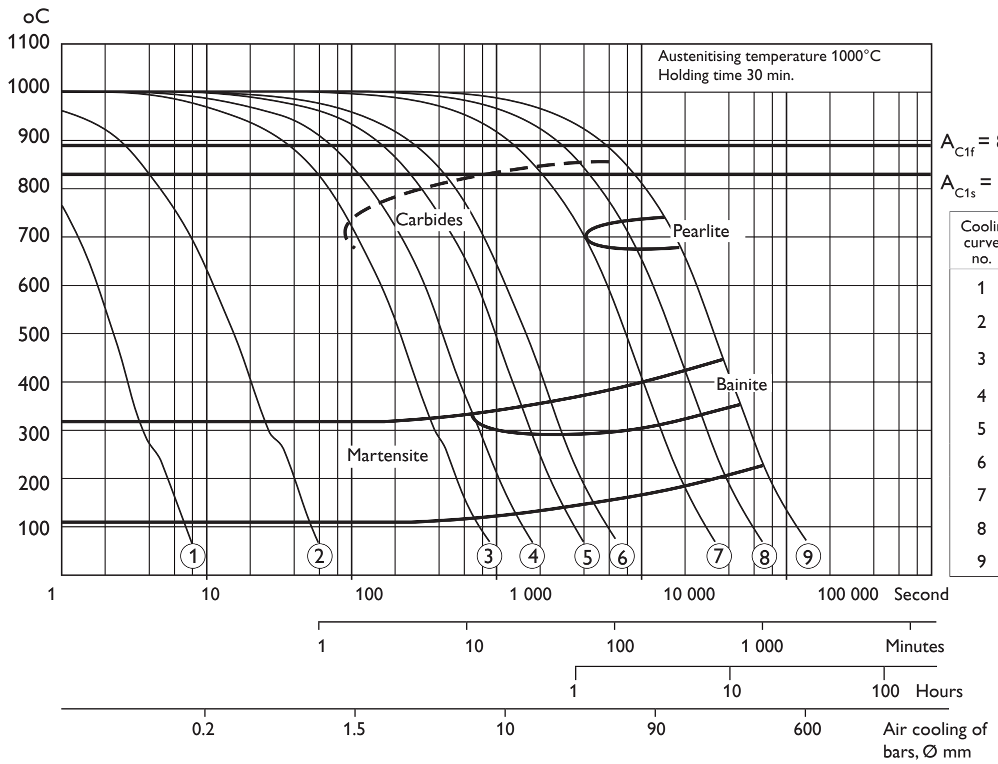
- High speed gas / circulating atmosphere.
- Vacuum (high speed gas with sufficient positive pressure). An interrupted quench at 350-450°C is recommended where distortion control and quench cracking are a concern,
- Martempering bath (salt or fluidised bed) at 500-550°C or 180-220°C.
- Warm oil, approx. 80°C

Note 1 : Temper the tool as soon as its temperature reaches 50 – 70 °C.

Note 2 : In order to obtain the optimum properties for the tool, the cooling rate should be as fast, but not at a level that gives excessive distortion or cracks.

CCT GRAPH

Austenitising temperature 1000°C. Holding time 30 minutes.



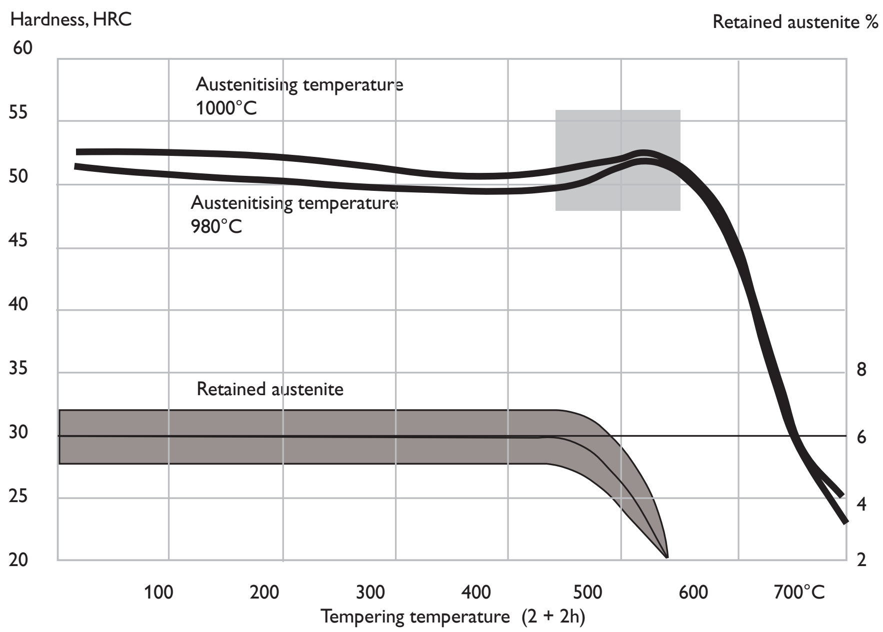
Cooling curve no.	Hardness HV10	T800-500 (sec)
1	657	1
2	642	10
3	592	140
4	585	280
5	585	630
6	579	1030
7	459	5200
8	446	10400
9	425	20800

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. Holding time at temperature is minimum 2 hours. Tempering in the temperature range 450-550°C for the intended final hardness will result in a lower toughness.

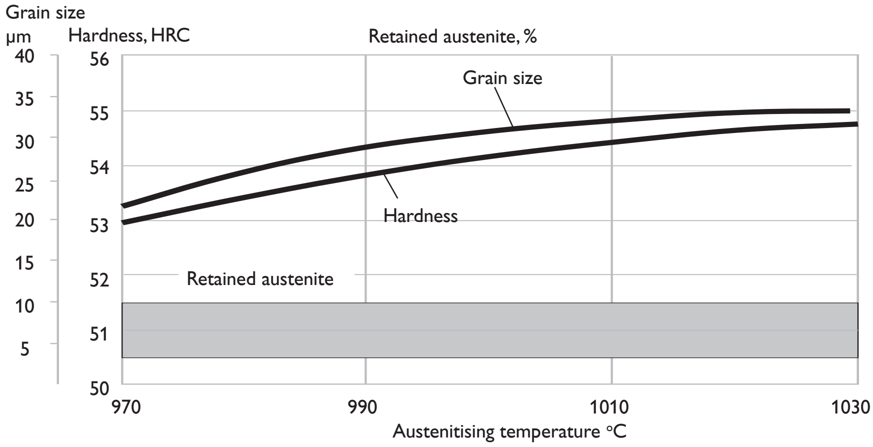
TEMPERING GRAPH

Air cooling of specimen 15 x 15 x 40 mm



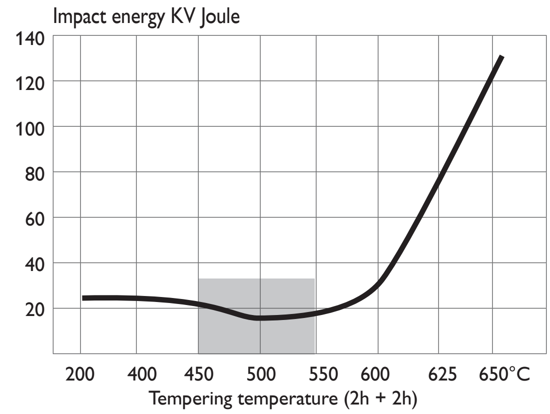
Above tempering curves are obtained after heat treatment of samples with a size of 15 x 15 x 40 mm, cooling in forced air. Lower hardness can be expected after heat treatment of tools and dies due to factors like actual tool size and heat treatment parameters.

HARDNESS, GRAIN SIZE AND RETAINED AUSTENITE AS A FUNCTION OF AUSTENITISING TEMPERATURE



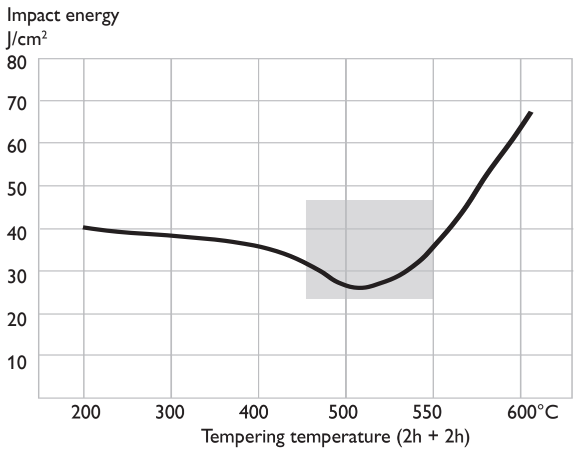
APPROXIMATE IMPACT ENERGY AT DIFFERENT TEMPERING TEMPERATURES

Charpy V specimens, short transverse direction.



Tempering in the temperature range 450–550°C for the intended final hardness will result in a lower toughness.

Charpy U specimens, short transverse direction.



DIMENSIONAL CHANGES DURING HARDENING AND TEMPERING

During hardening and tempering the die is exposed to thermal as well as transformation stresses. This will inevitably result in dimensional changes and in the work case distortion. It is therefore recommended to always leave a machining allowance after machining before the die is hardened and tempered. Normally the size in the largest direction will shrink and the size in the smallest direction might increase but this is also a matter of the die size, the die design as well as the cooling rate after hardening.

For Vidar Superior, it is recommended to leave a machining allowance of 0.2 per cent of the dimension in length, width and thickness.

NITRIDING AND NITROCARBURISING

Nitriding and nitrocarburising result in a hard surface layer which is very resistant to wear and erosion. The nitrided layer is, however, brittle and my crack or spall when exposed to mechanical or thermal shock, the risk increasing with layer thickness. Before nitriding, the tool should be hardened and tempered at a temperature at least 50°C above the nitriding temperature.

Nitriding in ammonia gas at 510°C or plasma nitriding in 75% hydrogen / 25% nitrogen at 480°C both result in a surface hardness of ~1100 $HV_{0.2}$.

In general, plasma nitriding is the preferred method because of better control over nitrogen potential; in particular, formation of the so-called "white layer", which is not recommended for hot-work service, can readily be avoided. However, careful gas nitriding can give perfectly acceptable results.

Vidar Superior can also be nitrocarburised in either gas or salt bath. The surface hardness after nitrocarburising is 1000–1100 $HV_{0.2}$.

DEPTH OF NITRIDING

Process		Depth
	Time	mm
Gas nitriding at 510°C	10 h	0.12
	30 h	0.21
Plasma nitriding at 480°C	10 h	0.10
	30 h	0.19
Nitrocarburising		
- in gas at 580°C	2.5 hr	0.13
- in salt bath at 580°C	1 hr	0.07

* Depth of case = distance from surface where hardness is 50 $HV_{0.2}$ over base hardness

Vidar Superior can also be nitrided in the soft annealed condition. The hardness and depth of case will, however, be reduced somewhat in this case.

MACHINING RECOMMENDATIONS

The cutting data 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
	Rough turning	Fine turning	Fine turning
Cutting speed (v_C), m/min	170 – 220	220 – 270	25 – 30
Feed (f) mm/rev	0.2 – 0.4	0.05 – 0.2	< 0.3
Depth of cut (a_p) mm	2 – 4	0.5 – 2	< 2
Carbide designation ISO	P20 - P30 Coated carbide	P10 Coated carbide or cermet	–

HSS = High Speed Steel

MILLING

FACE AND SQUARE SHOULDER MILLING

Cutting data parameters	Milling with carbide	
	Rough milling	Fine milling
Cutting speed (v_C) m/min	140 – 220	220 – 260
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 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	145 – 185	150 – 190	30 – 35 [1)]
Feed (f_z) mm/tooth	0.03 – 0.20 [2)]	0.08 – 0.20 [2)]	0.05 – 0.35 [2)]
Carbide designation ISO	–	P10 – P20	–

1) For coated High Speed Steel end mill, v_C~ 50 – 55 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	15 – 20*	0.05 – 0.10
5 – 10	15 – 20*	0.10 – 0.20
10 – 15	15 – 20*	0.20 – 0.25
15 – 20	15 – 20*	0.25 – 0.30

* For coated high speed steel drill, $v_C \sim 35 – 40$ m/min

CARBIDE DRILL

Cutting data parameters	Type of drill		
	Indexable insert	Solid carbide	Carbide tip [1)]
Cutting speed (v_C), m/min	200 – 230	120 – 150	120 – 150
Feed (f) mm/r	0.05 – 0.15 [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	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 IV	A 120 JV

ELECTRICAL DISCHARGE MACHINING — EDM

Following the EDM process, the applicable die surfaces are covered with a re-solidified layer (white layer) and a rehardened and untempered layer, both of which are very brittle and hence detrimental to die performance.

If EDM is used the white layer must be completely removed mechanically by grinding or stoning. After the finish machining the tool should also then be given an additional temper at approx. 25°C below the highest previous tempering temperature.

POLISHING

Vidar Superior has good polishability in the hardened and tempered condition because of a very homogeneous structure. This coupled with a low level of non metallic inclusions, due to ESR process, ensures good surface finish after polishing.

Note: Each steel grade has an optimum polishing time which largely depends on hardness and polishing technique. Over polishing can lead to a poor surface finish, “orange peel” or pitting.

Further information is given in the publication “Polishing of mould steel”.

PHOTOETCHING

Vidar Superior is particularly suitable for texturing by the photoetching method. Its high level of homogeneity and low sulphur content ensures accurate and consistent pattern reproduction.

WELDING

Welding of die components can be performed, With acceptable results, as long as the proper precautions are taken during the preparation of the joint, the filler material selection, the preheating of the die, the controlled cooling of the die and the post weld heat treatment processes. The following guidelines summarize the most important welding process parameters.

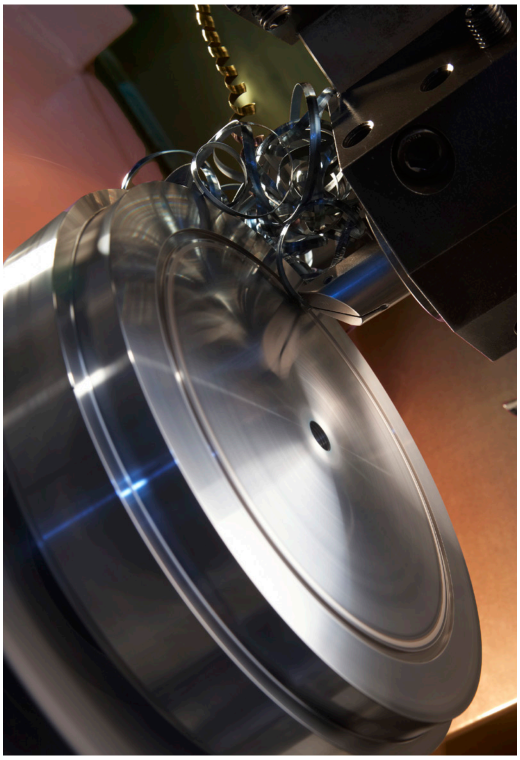
Welding Method	TIG	MMA
Preheating temperature	Min. 325°C	Min. 325°C
Filler metals	DIEVAR TIG-WELD QRO 90 TIG-WELD	UTP 673 QRO 90 WELD
Maximum interpass temperature	475°C	475°C
Post welding cooling	20 - 40°C/hr for the first 2-3 hours and then freely in air.	
Hardness after welding	48 - 53 HRC	55 - 58 HRC 48 - 53 HRC
Heat treatment after welding		
Hardened condition	Temper at 10-20 oC below the highest previous tempering temperature.	
Soft annealed condition	Soft anneal the material at 850°C in protected atmosphere. Then cool in the furnace at 10°C per hour to 650°C then freely in air.	

* Preheating temperature must be established throughout the die and must be maintained for the entirety of the welding process, to prevent weld cracking.

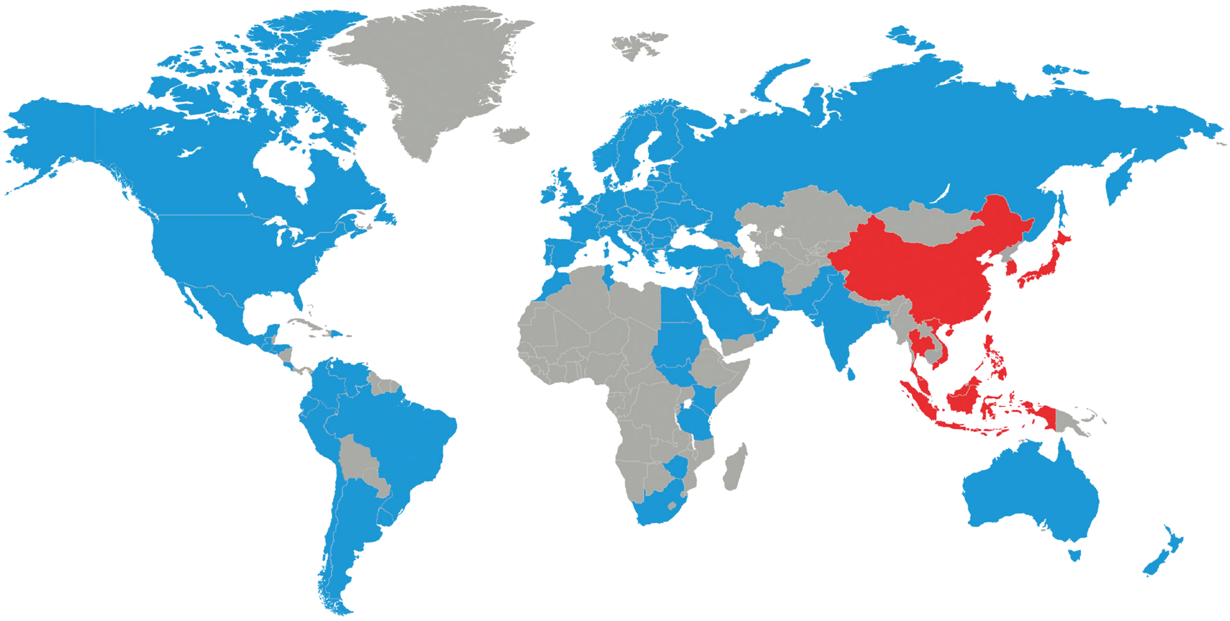
FURTHER INFORMATION

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

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
www.assab.com

UDDEHOLM
a voestalpine company

ASSAB