ASSAB 8407 SUPREME

UDDEHOLM ORVAR SUPREME

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 202100524

ASSAB 8407 Supreme

ASSAB 8407 Supreme can be regarded as an “all-round” steel used in several application areas. Except for hot work application areas the steel is also used in moulds for plastics and as a material in high stressed axles.

The high degree of purity and the very fine structure shows improvement in dies and components where high mechanical and thermal stresses are involved.

GENERAL

ASSAB 8407 Supreme is a chromium-molybdenum-vanadium-alloyed 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
- Good machinability and polishability
- Excellent through-hardening properties
- Good dimensional stability during hardening

Typical analysis %	C 0.39	Si 1.0	Mn 0.4	Cr 5.2	Mo 1.4	V 0.9
Standard specification	Premium AISI H13, W.-Nr. 1.2344					
Delivery condition	Soft annealed to approx. 180 HB					

IMPROVED TOOLING PERFORMANCE

The name "Supreme" implies that by special processing techniques and close control, the steel attains high purity and a very fine structure.

Further, ASSAB 8407 Supreme shows significant improvements in isotropic properties compared to conventionally produced AISI H 13 grades.

These improved isotropic properties are particularly valuable for tooling subjected to high mechanical and thermal fatigue stresses, e.g. die casting dies, forging tools and extrusion tooling. In practical terms, tools may be used at somewhat higher working hardnesses (+1 to 2 HRC) without loss of toughness. Since increased hardness slows down the formation of heat checking cracks, improved tool performance can be expected.

ASSAB 8407 Supreme meets the North American Die Casting Association (NADCA) #207-2011 for premium high quality H-13 die steel.

APPLICATIONS

TOOLS FOR DIE CASTING

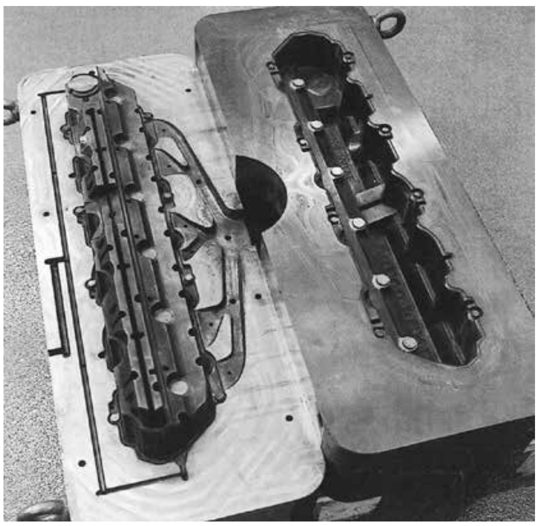
Part	Tin, lead zinc alloys HRC	Aluminium, magnesium alloys, HRC	Copper alloys HRC
Dies	46 - 50	42 - 48	QRO 90 Supreme
Fixed inserts cores	46 - 52	44 - 48	QRO 90 Supreme
Sprue parts	48 - 52	46 - 48	QRO 90 Supreme
Nozzles	35 - 42	42 - 48	QRO 90 Supreme
Ejector pins (nitrided)	46 - 50	46 - 50	46 - 50
Pluner, shot sleeve (normally nitrided)	42 - 46	42 - 48	QRO 90 Supreme
Austenitising temperature	1020 - 1030 °C		1040 - 1050 °C

TOOLS FOR EXTRUSION

Part	Aluminium magnesium alloys, HRC	Copper alloys HRC	Stainless steel HRC
Dies	44 - 50	43 - 47	45 - 50
Backers, die-holders, liners, dummy blocks, stems	41 - 50	40 - 48	40 - 48
Austenitising temperature (approx.)	1020 - 1030 °C	1040 - 1050 °C	

TOOLS FOR HOT PRESSING

Material	Aust. temp (approx.) °C	HRC
Aluminium, magnesium	1020 - 1030	44 - 52
Copper alloys	1040 - 1050	44 - 52
Steel	1040 - 1050	40 - 50



MOULDS FOR PLASTICS

Part	Austenitising temp	HRC
Injection moulds	1020 - 1030 °C	
Compression/ transfer moulds	Tempering 1. ≥550 °C or 2. 250 °C	40 - 52 50 - 53

OTHER APPLICATIONS

Application	Austenitising temp	HRC
Severe cold punching, scrap shears	1020 - 1030 °C Tempering 250 °C	50 - 53
Hot shearing	1020 - 1030 °C Tempering 1. 250 °C or 2. 575-600 °C	50 - 53 45 - 50
Shrink rings (e.g. for cemented carbide dies)	1020 - 1030 °C Tempering 575 - 600 °C	45 - 50
Wear resisting parts	1020 - 1030 °C Tempering 575 °C Nitriding	Core 50 - 52 Surface ~1000 HV_1

PROPERTIES

All specimens are taken from the centre of a 407 x 127 mm bar. Unless otherwise is indicated all specimens were hardened 30 minutes at 1025 °C, quenched in air and tempered 2 + 2 h at 610 °C. The hardness were 45 ± 1 HRC.

PHYSICAL DATA

Data at room and elevated temperatures.

Temperature	20 °C	400 °C	600 °C
Density kg/m³	7 800	7 700	7 600
Modulus of elasticity MPa	210 000	180 000	140 000
Coefficient of thermal expansion per °C from 20 °C	-	12.6×10^{-6}	13.2×10^{-6}
Thermal conductivity W/m°C	25	29	30

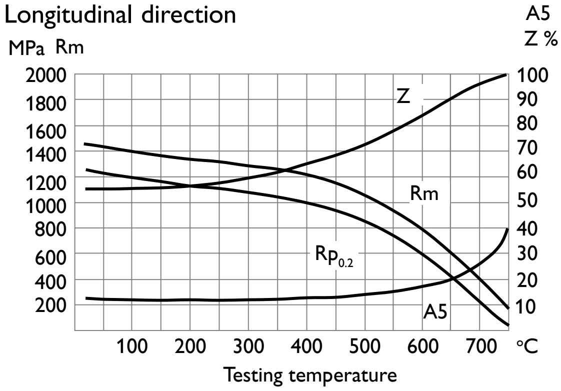
MECHANICAL PROPERTIES

Approximate tensile strength at room temperature.

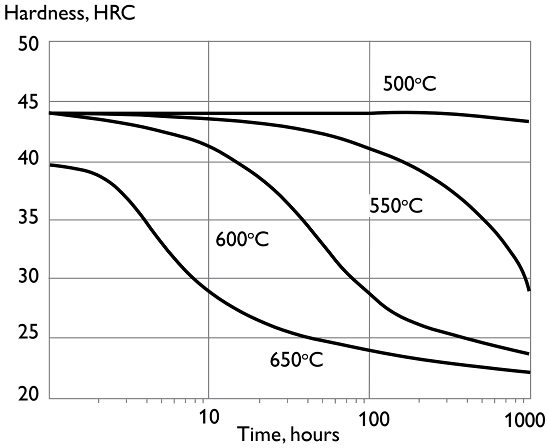
Hardness	52 HRC	45 HRC
Tensile strength Rm	1 820 MPa	1 420 MPa
Yield strength $Rp_{0.2}$	1 520 MPa	1 280 MPa

APPROXIMATE STRENGTH AT ELEVATED TEMPERATURES

Longitudinal direction

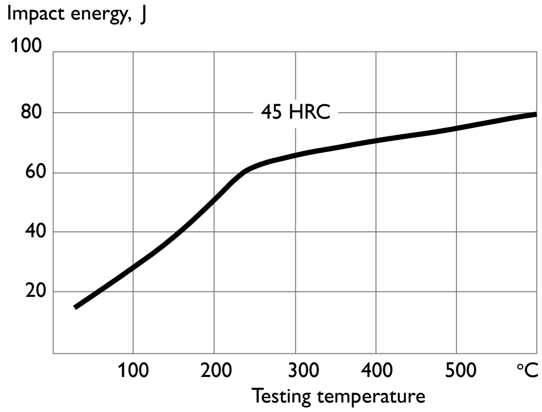


EFFECT OF TIME AT HIGH TEMPERATURES ON HARDNESS



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

HARDENING

Preheating temperature: 600 - 850 °C, normally in two pre-heating steps.

Austenitising temperature: 1020 - 1050 °C, normally 1020 - 1030 °C.

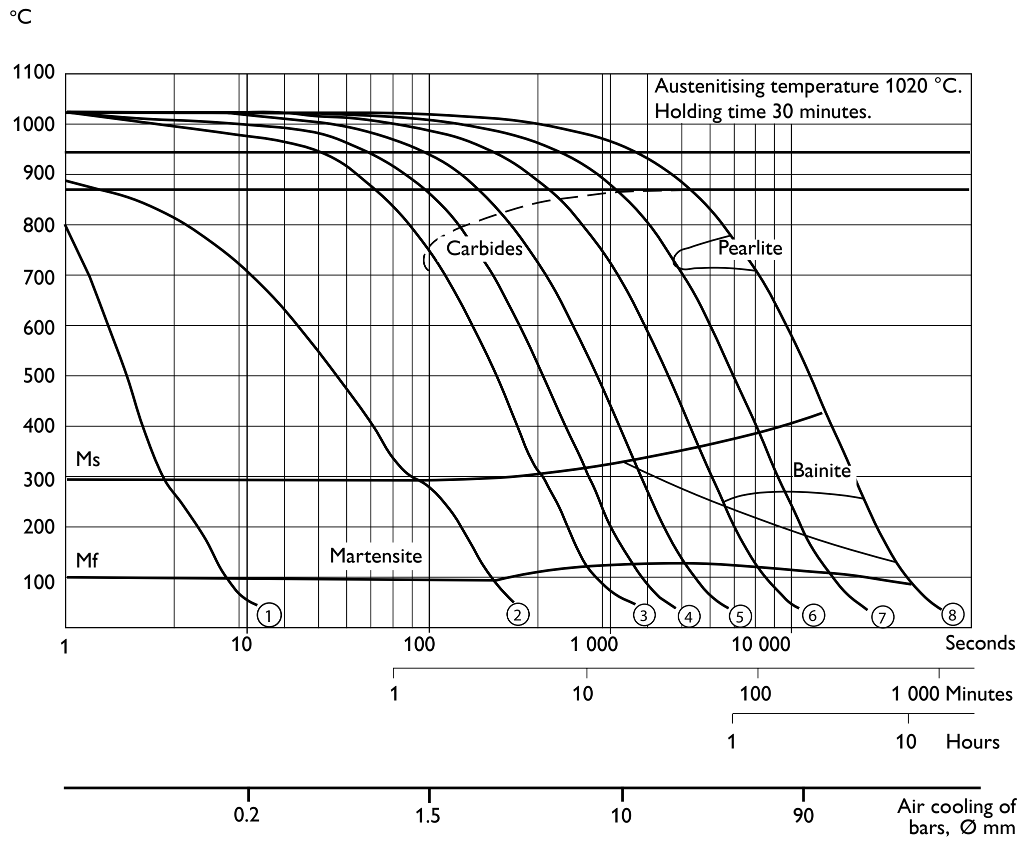
Temperature °C	Soaking time* minutes	Hardness before tempering HRC
1025	30	53±2
1050	15	54±2

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

Protect the part against decarburisation and oxidation during hardening.

CCT-GRAPH

Austenitising temperature 1020 °C. Holding time 30 minutes.



A_{C1f} = 950 °C

A_{C1s} = 870 °C

Cooling Curve No.	Hardness HV 10	$T_{800-500}$ sec
1	681	1
2	620	37
3	606	160
4	601	280
5	585	560
6	560	1 390
7	537	3 220
8	473	8 360

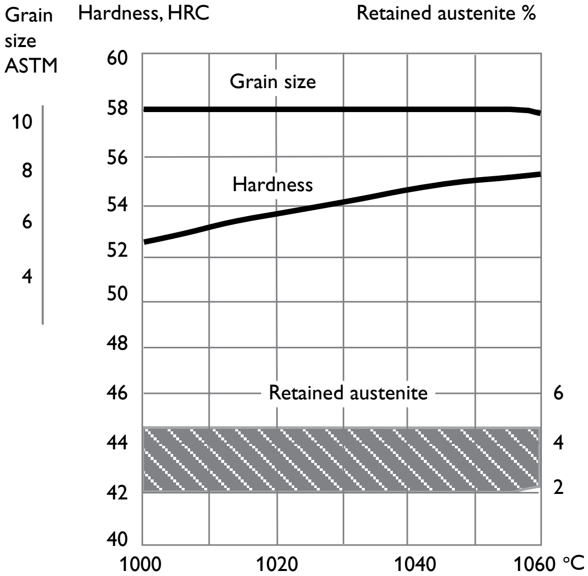
QUENCHING MEDIA

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

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 fast, but not at a level that gives excessive distortion or cracks.

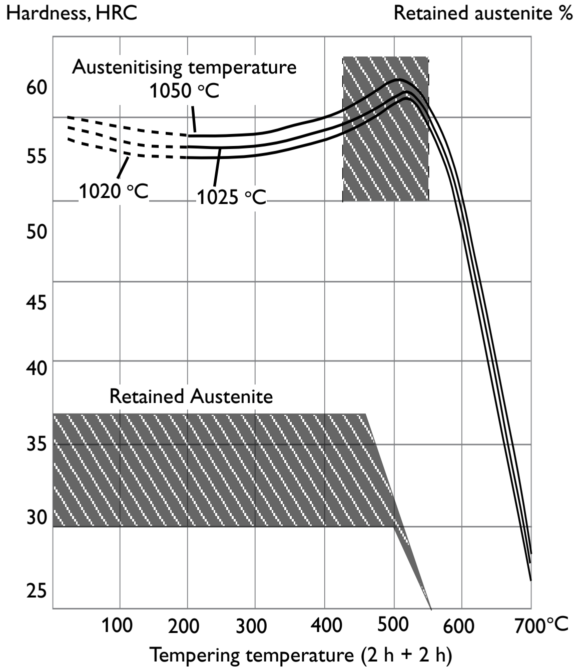
HARDNESS, GRAIN SIZE AND RETAINED AUSTENITE AS FUNCTIONS OF AUSTENITISING TEMPERATURE



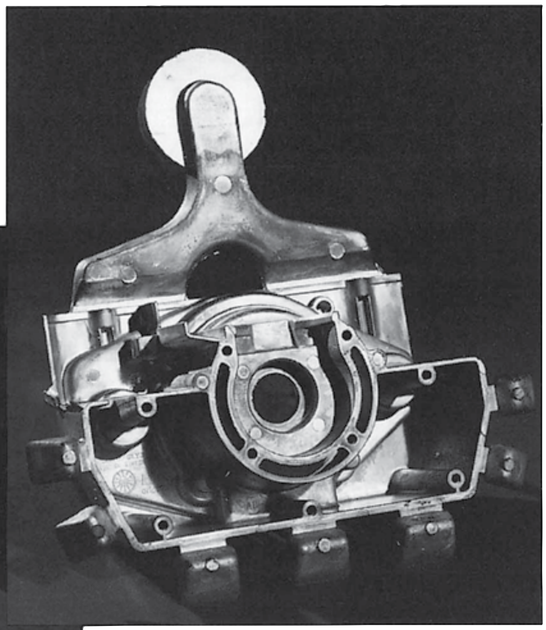
TEMPERING

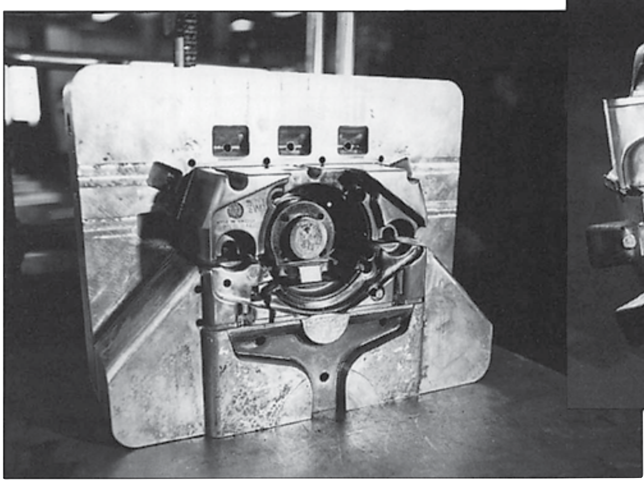
Choose the tempering temperature according to the hardness required by reference to the tempering graph. Temper minimum twice with intermediate cooling to room temperature.

Lowest tempering temperature 250 °C. Holding time at temperature minimum 2 hours. To avoid "temper brittleness", do not temper in the range 425 – 550 °C, see graph.



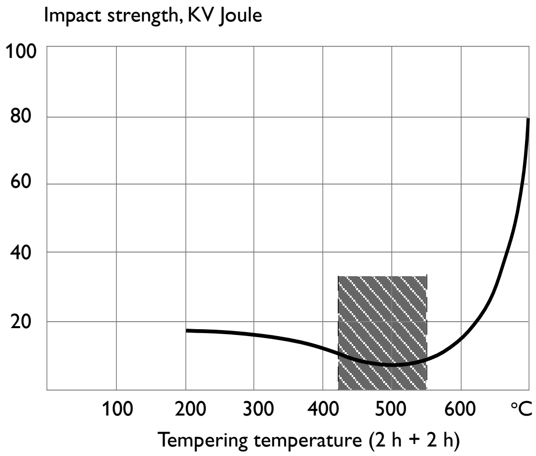
Above tempering curves are obtained after heat treatment of samples with a size of 15 x 15 x 40 mm, cooling in forced air. Lower hardness can be expected after heat treatment of tools and dies due to factors like actual tool size and heat treatment parameters.





APPROXIMATE IMPACT STRENGTH AT DIFFERENT TEMPERING TEMPERATURES

Charpy V specimens, short transverse direction.



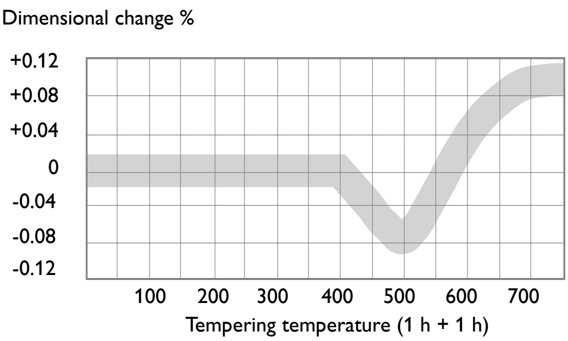
Tempering within the range 425 – 550 °C is normally not recommended due to the reduction in toughness properties avoided.

DIMENSIONAL CHANGES DURING HARDENING

Sample plate, 100 x 100 x 25 mm

		Width %	Length %	Thickness %
Oil hardened from 1020 °C	Min	-0.08	-0.06	±0
	Max	-0.15	-0.16	+0.30
Air hardened from 1020 °C	Min	-0.02	-0.05	±0
	Max	+0.03	+0.02	+0.05
Vac hardened from 1020 °C	Min	+0.01	-0.02	+0.08
	Max	+0.02	-0.04	+0.12

DIMENSIONAL CHANGES DURING TEMPERING



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

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 may 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 25 – 50 °C above the nitriding temperature.

Nitriding in ammonia gas at 510 °C or plasma nitriding in a 75% hydrogen/25% nitrogen mixture at 480 °C both result in a surface hardness of about 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.

ASSAB 8407 Supreme can also be nitrocarburised in either gas or salt bath. The surface hardness after nitrocarburising is 900 – 1000 $HV_{0.2}$.

DEPTH OF NITRIDING

Process	Time	Depth mm
Gas nitriding at 510 °C	10 h 30 h	0.12 0.20
Plasma nitriding at 480 °C	10 h 30 h	0.12 0.18
Nitrocarburising - in gas at 580 °C - in salt bath at 580 °C	 2.5 h 1 h	 0.11 0.06

Nitriding to case depths >0.3 mm is not recommended for hot work applications.

ASSAB 8407 Supreme can 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	200 – 250	250 – 300	25-30
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	-

DRILLING

HIGH SPEED STEEL TWIST DRILL

Drill diameter mm	Cutting speed (v_C) m/min	Feed (f) mm/r
≤ 5	16 – 18 *	0.05 – 0.15
5 – 10	16 – 18 *	0.15 – 0.20
10 – 15	16 – 18 *	0.20 – 0.25
15 – 20	16 – 18 *	0.25 – 0.35

* For coated high speed steel drill V_C = 28 - 30 m/min

CARBIDE DRILL

Cutting data parameters	Type of drill		
	Indexable insert	Solid carbide	Carbide tip[1]
Cutting speed (v_C), m/min	220 – 240	130 – 160	80 – 110
Feed (f_z) mm/tooth	0.03 – 0.12 [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 – 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	160 – 200	170 – 230	35 – 40[1]
Feed (f_z) mm/tooth	0.03 – 0.20 [2]	0.08 – 0.20 [2]	0.05 – 0.35 [2]
Depth of cut (a_p) mm	-	P20, P30	-

1) For coated high speed steel end mill Vc = 55 – 60 m/min
2) Depending on radial depth of cut and cutter diameter

GRINDING

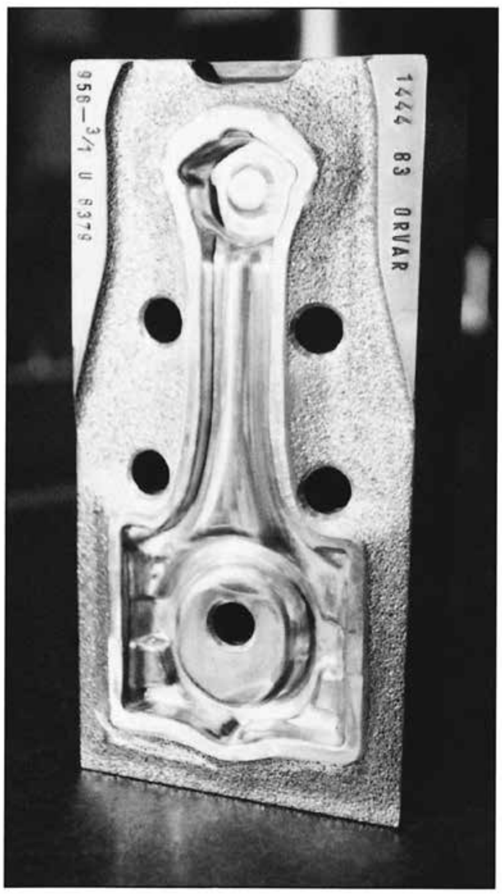
A general grinding wheel recommendation is given below. More information can be found in the publication "Grinding of tool steel".

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 KV

WELDING

Welding of tool steel can be performed with good results if proper precautions are taken regarding elevated temperature, joint preparation, choice of consumables and welding procedure.

Welding method	TIG	MMA
Working temperature	325 - 375 °C	325 - 375 °C
Welding consumables	QRO 90 TIG Weld DIEVAR TIG Weld	QRO 90 Weld
Cooling rate	20 - 40 °C/h the first 2 - 3 h then freely in air.	
Hardness after welding	50 - 55 HRC	50 - 55 HRC
Heat treatment after welding:		
Hardened condition	Temper at 10 - 20 °C below the original 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.	



ELECTRICAL DISCHARGE MACHINING — EDM

If spark-erosion is performed in the hardened and tempered condition, the white re-cast layer should be removed mechanically e.g. by grinding or stoning. The tool should then be given an additional temper at approx. 25 °C below the previous tempering temperature.

HARD CHROMIUM PLATING

After plating, parts should be tempered at 180 °C for 4 hours within 4 hours of plating to avoid the risk of hydrogen embrittlement.

POLISHING

ASSAB 8407 Supreme 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. Overpolishing can lead to a poor surface finish, “orange peel” or pitting.

PHOTO-ETCHING

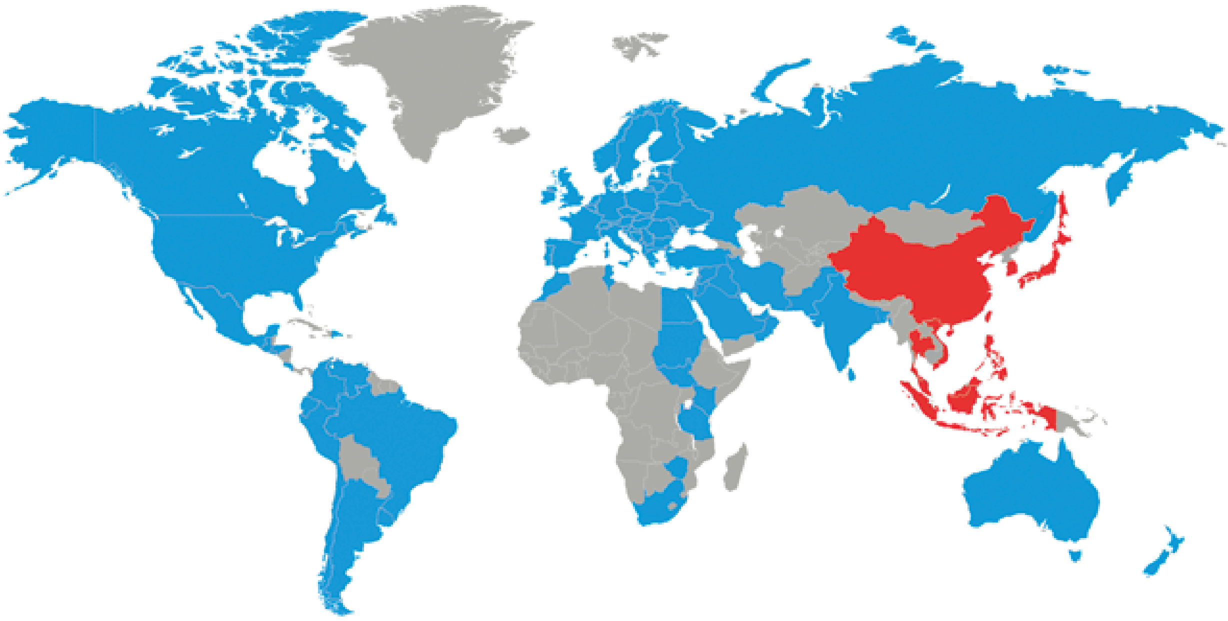
ASSAB 8407 Supreme is particularly suitable for texturing by the photo-etching method. Its high level of homogeneity and low sulphur content ensures accurate and consistent pattern reproduction.

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