ASSAB 2344

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 20210505

GENERAL

ASSAB 2344 is a chromium-molybdenumvanadium-alloyed tool steel which is characterised by:

- Good resistance to abrasion at both low and high temperatures
- High level of toughness and ductility
- Good machinability and polishability
- Good high-temperature strength and resistance to thermal fatigue
- Excellent through-hardening properties
- Very limited distortion during hardening

Typical analysis %	C 0.39	Si 1.1	Mn 0.4	Cr 5.2	Mo 1.4	V 0.9
Standard specification	AISI H13, WNr. 1.2344, SKD 61, EN X40CrMoV5-1					
Delivery condition	Soft annealed to approx. 205 HB.					

Aluminium extrusion profiles

APPLICATIONS

PLASTIC MOULDING

Part	Austenitising and tempering temperature	HRC
Injection moulds, Compression/ transfer moulds	Austenitising 1020 - 1030°C Tempering 250 °C	50 – 52

EXTRUSION

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

DIE CASTING

Part	Tin, lead zinc alloys HRC	Aluminium magnesium alloys, HRC
Dies	46 – 50	42 - 48
Fixed inserts, cores	46 - 52	44 - 48
Sprue parts	48 - 52	46 - 48
Nozzles	35 - 42	42 -48
Ejector pins (nitrided)	46 - 50	46 - 50
Plunger, short-sleeve (normally nitrided)	42 - 46	42 - 48
Austenitising temp.	1020 - 1030°C	

OTHER APPLICATIONS

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

Other applications also include forming dies, die inserts, and tools for the manufacture of screws nuts, riverts and bolts.

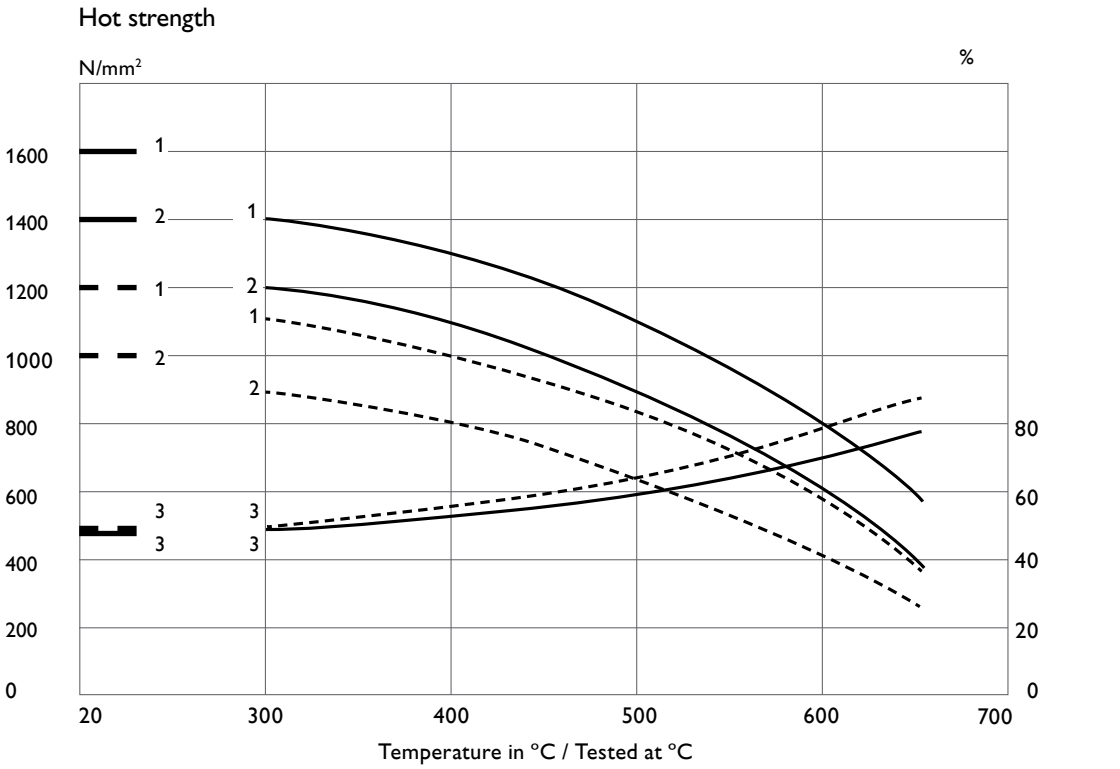
PROPERTIES

PHYSICAL DATA

Unless otherwise 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.

Temperature	20 °C	200 °C	400 °C
Density, kg/m^3	7 800	7 700	7 600
Modulus of elasticity N/mm^2	215 000	180 000	165 000
Coefficient of thermal expansion /°C from 20°C	-	12.5 x 10^{-6}	13.0 x 10^{-6}
Thermal conductivity* W/m °C	24	28	28

MECHANICAL PROPERTIES



Heat treated 1600 N/mm^2 (48 - 49 HRC)

Heat treated 1200 N/mm^2 (38 - 39 HRC)

1 ..... Tensile strength N/mm^2

2 ..... 0.2% proof stress N/mm^2

3 ..... Reduction of area %

HEAT TREATMENT

SOFT ANNEALING

Protect the steel and heat through to 750 - 800°C. Then cool in the furnace at 10 - 20°C per hour to 600°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 preheating 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 tool against decarburisation and oxidation during hardening.

QUENCHING MEDIA

- High-speed gas/circulating atmosphere
- High-speed gas with sufficient positive pressure quenching in vacuum furnace. Interrupted quench is recommended for distortion control, or when quench cracking is 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.

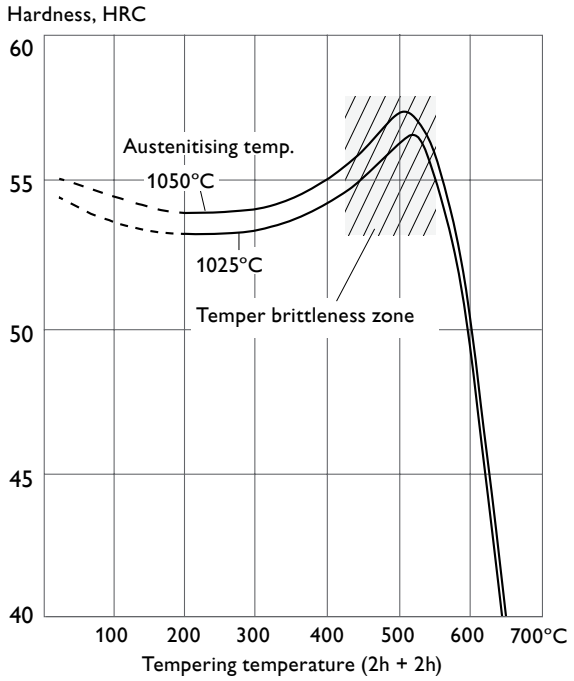
Note 2: In order to obtain the optimum properties for the tool, the cooling rate should be fast, but not at a level that gives excessive distortion or cracks.

TEMPERING

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

The lowest tempering temperature which should be used is 180°C. The minimum holding time at tempering temperature is 2 hours. To avoid "temper brittleness", do not temper in the range 425 - 550°C, see graph.

TEMPERING GRAPH



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

MACHINING RECOMMENDATIONS

The cutting data below are to be considered as guiding values and as starting points for developing your own best practice.

Condition: Soft-annealed condition ~185 HB

TURNING

Cutting data parameters	Turning with carbide		Turning with High speed steel Fine turning
	Rough 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 - 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	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 HSS 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) mm/r	0.03 – 0.10 [2]	0.10 – 0.25 [2]	0.15 – 0.25 [2]

[1] Drill with replaceable or brazed carbide tip
[2] Depending on drill diameter

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 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	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]
Carbide designation ISO	–	P20 – P30	–

[1] For coated HSS end mill, vc ~ 55 – 60 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
Profile grinding	A 100 LV	A 120 KV

SURFACE TREATMENT

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. Particularly, plasma nitriding can readily avoid the formation of so-called white layer, which is not recommended for hot work service. However, careful gas nitriding can give perfectly acceptable results.

ASSAB 2344 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, h	Depth, mm
Gas nitriding at 510°C	10 30	0.12 0.20
Plasma nitriding at 480°C	10 30	0.12 0.18
Nitrocarburising - in gas at 580°C	2.5	0.11
- in salt bath at 580°C	1	0.06

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

ASSAB 2344 can be nitrided in the soft-annealed condition. The hardness and depth of case will, however, be reduced somewhat in this case.

HARD CHROME 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.

ELECTRICAL DISCHARGE MACHINING — EDM

If spark-erosion is performed in the hardened and tempered condition, the white re-cast layer should be removed mechanically by grinding or stoning.

The tool should then be given an additional temper at approx. 25°C below the previous tempering temperature.

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. The following guidelines summarise the most important welding process parameters.

Welding method	TIG	MMA
Working temperature	325 - 375 °C	325 - 375 °C
Filler metals	QRO 90 TIG Weld DIEVAR TIG Weld UTP A 673	QRO 90 Weld UTP A 673
Cooling rate	20 - 40 °C/h for the first 2 - 3 hours and then freely in air.	
Hardness after welding	QRO 90 TIG-WELD DIEVAR TIG-WELD 48 - 53 HRC UTP A 673 57 - 60 HRC	QRO 90 TIG-WELD 48 - 53 HRC UTP 673 55 - 58 HRC
Heat treatment after welding		
Hardened condition	Temper at 25°C below the original tempering temperature.	
Soft annealed condition	Soft anneal according to the "Heat treatment" recommendation.	

POLISHING

ASSAB 2344 exhibits good polishability in the hardened and tempered condition. Polishing after grinding can be effected using aluminium oxide or diamond paste.

TYPICAL PROCEDURE

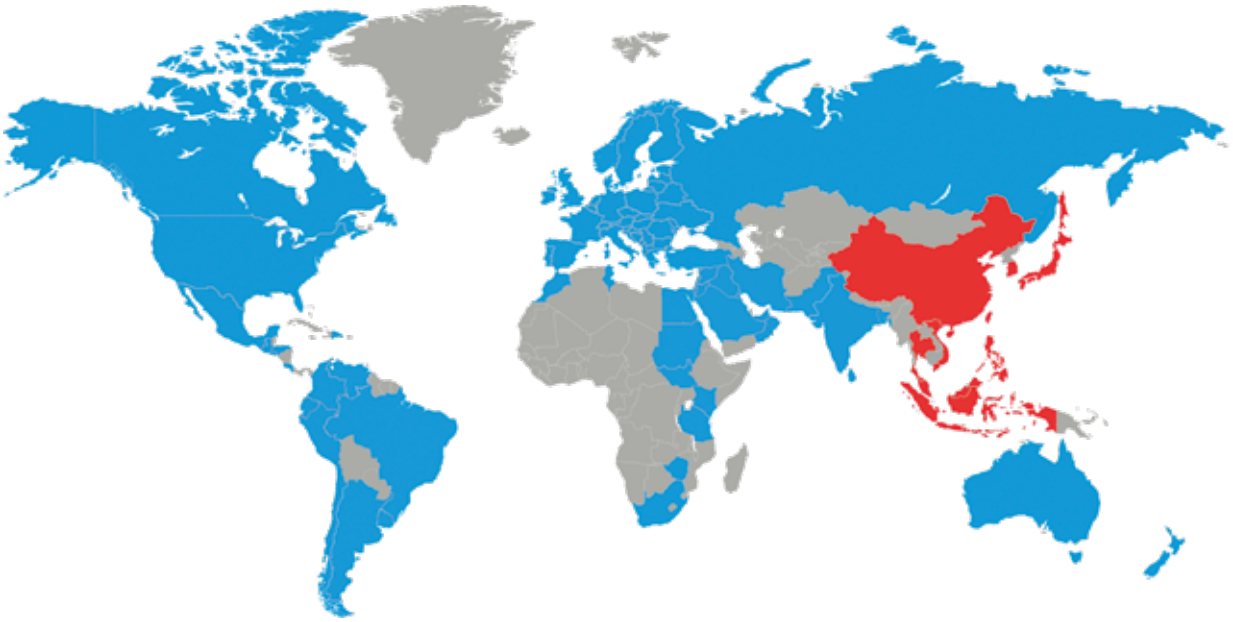
1. Rough grinding to 180 - 320 grain size using a wheel or stone.
2. Fine grinding with abrasive paper or powder, down to 400 - 800 grain size.
3. Polish with diamond paste grade 15 (15µm grain size) using a polishing tool of soft wood or fibre.
4. Polish with diamond paste 8-6-3 (8-6-3µm grain size) using a polishing tool of soft wood or fibre.
5. When demands on surface finish are high, grade 1 (1µm grain size) diamond paste can be used for final polishing with a fibre polishing pad.

PHOTO-ETCHING

ASSAB 2344 is 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.



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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