ASSAB XW-42

UDDEHOLM SVERKER 21

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

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Edition 20210505

GENERAL

ASSAB XW-42 is a high-carbon, high-chromium tool steel alloyed with molybdenum and vanadium characterised by:

- High wear resistance
- High compressive strength
- High hardness after hardening
- Good through-hardening properties
- Good dimension stability during heat treatment
- Good resistance to tempering back

Typical analysis %	C 1.55	Si 0.3	Mn 0.3	Cr 11.6	Mo 0.8	V 0.8
Standard specification	AISI D2, WNr. 1.2379, SKD 11					
Delivery condition	Soft annealed to approx. 240 HB					

APPLICATIONS

ASSAB XW-42 is recommended for tools requiring very high wear resistance, combined with moderate toughness (shock resistance). ASSAB XW-42 is a versatile tool steel, which can be used for a wide variety of cold work applications including blanking and other cutting processes, and several forming processes.

ASSAB XW-42 can be supplied in various surface executions including hot rolled, pre-machined, and fine machined condition. It is also available in the form of hollow bars.

BLANKING AND CUTTING

Application	Material thickness, mm	Work material hardness (HB)	
		≤180 HRC	>180 HRC
Tools for: Blanking, punching, piercing, cropping, shearing, trimming, clipping	< 3 mm	60 - 62	58 - 60
	3 - 6 mm	58 - 60	54 - 56
	6 - 10 mm	54 - 56	-
Short cold sheears Shredding knives for plastic waste Granulator knives			56 - 60
Circular shears			58 - 60
Clipping, timming tools for forgings		Hot	58 - 60
		Cold	56 - 58
Wood milling cutters, reamers, broachers			58 - 60

FORMING AND OTHER APPLICATIONS

Application	Hardness HRC
Tools for: Blending, raising, deep-drawing, rim-rolling, spinning and flow-turning	56 - 62
Coining dies	56 - 60
Cold extrusion dies, punches	58 - 60 56 - 60
Tube forming rolls, section forming rolls, plain rolls	58 - 62
Dies for moulding of: Ceramics, bricks, tiles, grinding wheels, tablets, abrasive plastics	58 - 62
Thread rolling dies	58 - 62
Cold heading tools	56 - 60
Crushing hammers	56 -60
Swaging tools	56 - 60
Gauges, measuring tools, guide rails, bushes, sleeves, knurling tools, sandblast nozzles	58 - 62

PROPERTIES

PHYSICAL DATA

Hardened and tempered to 62 HRC.

Temperature	20 °C	200 °C	400 °C
Density kg/m^3	7 700	7 650	7 600
Modulus of elasticity MPa	210 000	200 000	-
Coefficient of thermal expansion per °C from 20 °C	-	11.7 x 10^{-6}	12.8 x 10^{-6}
Thermal conductivity W/m °C	20	21	-
Specific heat J/kg °C	460	-	-

COMPRESSIVE STRENGTH

Approximate compressive strength versus hardness at room temperature.

Hardness HRC	Strength MPa	
	R_{mc}	$R_c0.2$
56	2 070	1 510
58	2 200	1 620
60	2 950	2 150
62	3 100	2 200

* R_{mc} Compressive strength
$R_c0.2$ Compressive yield strength

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 held for 2 hours. Cool slowly to 500 °C, then freely in air.

HARDENING

Preheating temperature: 650 – 750 °C.

Austenitising temperature: 990 – 1050 °C, but usually 1000 – 1040 °C.

Temperature °C	Soaking time* min	Hardness before tempering HRC
990	60	63 ± 2
1 010	45	63 ± 2
1 030	30	63 ± 2

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

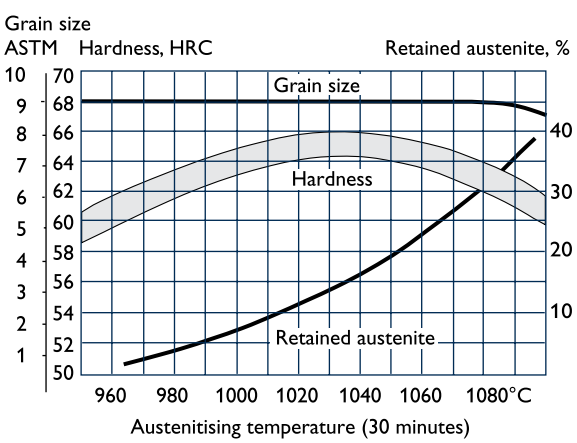
Protect the tool against decarburisation and oxidation during austenitising.

QUENCHING MEDIA

- Forced gas/circulating atmosphere.
- Vacuum (high speed gas with sufficient overpressure).
- Martempering bath or fluidised bed at 180-500°C then cool in air blast.
- Circulating air or atmposhere
- Warm oil, approx. 80°C (only very simple geometries).

Note: Temper the tool as soon as its temperature reaches 50 - 70°C. ASSAB XW-42 hardens through in all standard sizes.

HARDNESS AS FUNCTION OF AUSTENISING TEMPERATURE



SUB-ZERO TREATMENT

Pieces requiring maximum dimensional stability should be sub-zero treated, as volume changes may occur in the course of time. This applies, for example, to measuring tools like gauges and certain structural components.

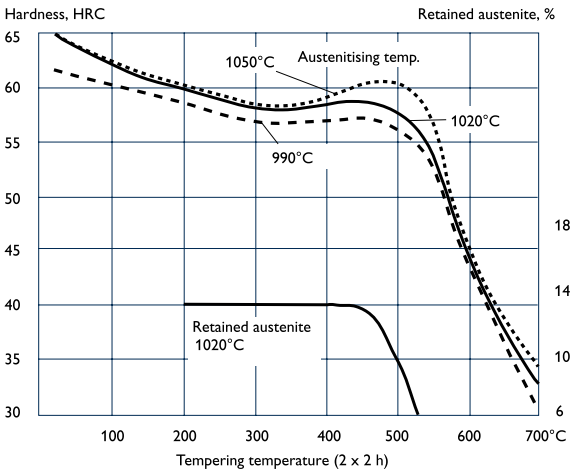
Immediately after quenching, the piece should be sub-zero treated between -120 and -150°C, soaking time 3 - 4 hours, followed by tempering. Sub-zero treatment will give a hardness increase of 1 - 3 HRC.

Avoid intricate shapes as there will be risk of cracking.

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 temperature is 2 hours.

TEMPERING GRAPH



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 ~210 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	100 – 150	150 – 200	12 – 15
Feed (f) mm/rev	0.2 – 0.4	0.05 – 0.2	0.05 – 0.3
Depth of cut (a_p) mm	2 – 6	≤ 2	≤ 2
Carbide designation ISO	K15 - K20*	K15 - K20*	–

* Use a wear-resistant Al_2O_3 coated carbide grade

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 – 0.35

* For coated high speed steel drill, v_C = 18 - 20 m/min

CARBIDE DRILL

Cutting data parameters	Type of drill		
	Indexable insert	Solid carbide	Carbide tip [1]
Cutting speed (v_C), m/min	130 – 150	70 – 90	35 – 45
Feed (f) mm/r	0.05 – 0.25 [2]	0.10 – 0.25 [2]	0.15 – 0.25 [2]

[1] Drill with replaceable or brazed carbide tip
[2] Depnding 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	90 – 130	130 – 180
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	K20, P20*	K20, P20*

* Use a wear-resistant Al_2O_3 coated carbide grade

END MILLING

Cutting data parameters	Type of milling		
	Solid carbide	Carbide indexable insert	High speed steel
Cutting speed (v_C), m/min	70 – 100	80 – 110	12 – 17 [1]
Feed (f_z) mm/tooth	0.03 – 0.20 [2]	0.08 – 0.20 [2]	0.05 – 0.35 [2]
Carbide designation ISO	–	K15 – K20	–

[1] For coated HSS end mill, Vc = 25 - 30 m/min
[2] Depending on radial depth of cut and cutter diameter
[3] Use a wear-resistant Al_2O_3 coated carbide grade

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	B151 R75 B3 [1] A 46 GV [2]
Face grinding segments	A 24 GV	3SG 36 HVS [2] A 36 GV
Cylindrical grinding	A 46 KV	B126 R75 B3 [1] A 60 KV [2]
Internal grinding	A 46 JV	B126 R75 B3 [1] A 60 HV
Profile grinding	A 100 LV	B126 R100 B6 [1] A 120 JV [2]

[1] If possible, use CBN wheels for this application
[2] Preferably a wheel type containing sintered Al_2O_3

WELDING

There is a general tendency for tool steel to crack after welding. When welding is required, take proper precautions with regards to joint preparation, filler material selection, preheating, welding procedure and postweld heat treatment to ensure good welding results. If the tool is to be polished or photo-etched, it is necessary to work with an electrode type of matching composition.

Welding method	TIG	MMA
Preheating temperature [1]	250 °C	250 °C
Filler metals	Inconel 625-type (buffering layers) UTP A73G2 UTP A67S UTP A696 CastoTIG 5 [3]	Inconel 625-type (buffering layers) UTP 67S UTP 69 Castolin 2 Castolin 6
Maximum interpass temp. [2]	400 °C	400 °C
Postweld cooling	20 - 40 °C/h for the first 2 hour, then freely in air <70 °C	
Hardness after welding	Inconel 625-type (buffering layers) 280 HB UTP A696 / CastoTIG 5 60 - 64 HRC UTP A67S 55 - 58 HRC UTP A73G2 53 - 56 HRC	Inconel 625-type (buffering layers) 280 HB UTP 69 / Castolin 6 59 - 61 HRC Castolin 2 56 - 60 HRC UTP 67S 55 - 58 HRC
Heat treatment after welding		
Hardened condition	Temper 10 - 20°C below the original tempering temperature.	
Soft annealed condition	Soft anneal according to the "Heat treatment" recommendation.	

1) Preheating temperature must be established throughout the tool and must be maintained for the entire welding process, to prevent weld cracking. For hardened and tempered tool, the actual preheat temperature used is typically lower than the original tempering temperature to prevent a drop in hardness.

2) The temperature of the tool in the weld area immediately before the second and subsequent pass of a multiple pass weld. When exceeded, there is a risk of distortion of the tool or soft zones around the weld.

3) Should not be used for more than 4 layers because of the increased risk of cracking.

SURFACE TREATMENT

NITRIDING AND NITROCARBURISING

Nitriding gives a hard surface layer, which is very resistant to wear and erosion. A nitrided surface also increases the corrosion resistance. For best result, the following steps should be followed:

1. Rough machining
2. Stress tempering at 650°C, holding time 2 hours. Cool slowing to 500°C, then freely in air.
3. Fine machining
4. Nitriding

Process	Time, h	Surface hardness, $HV_{0.2}$	Depth* mm
Gas nitriding at 510°C	10 30 60	1 100 1 100 1 100	0.11 0.15 0.21
Plasma nitriding at 480°C	10 30 60	1 150 1 150 1 150	0.13 0.17 0.22
Gas nitrocarburising at 580°C	2.5	850	0.10

* Nitriding depth is the distance from the surface where hardness is 50 HV higher than the matrix hardness

ELECTRICAL DISCHARGE MACHINING — EDM

If EDM is performed in the hardened and tempered condition, the EDM'd surface is covered with a resolidified layer (white layer) and a rehardened and untempered layer, both of which are very brittle and hence detrimental to the tool performance.

When a profile is produced by EDM, it is recommended to finish with "fine-sparking", i.e., low current, high frequency. For optimal performance, the EDM'd surface should be ground/polished to remove the white layer completely. The tool should then be retempered at approx. 25°C below the highest previous tempering temperature.

Further information

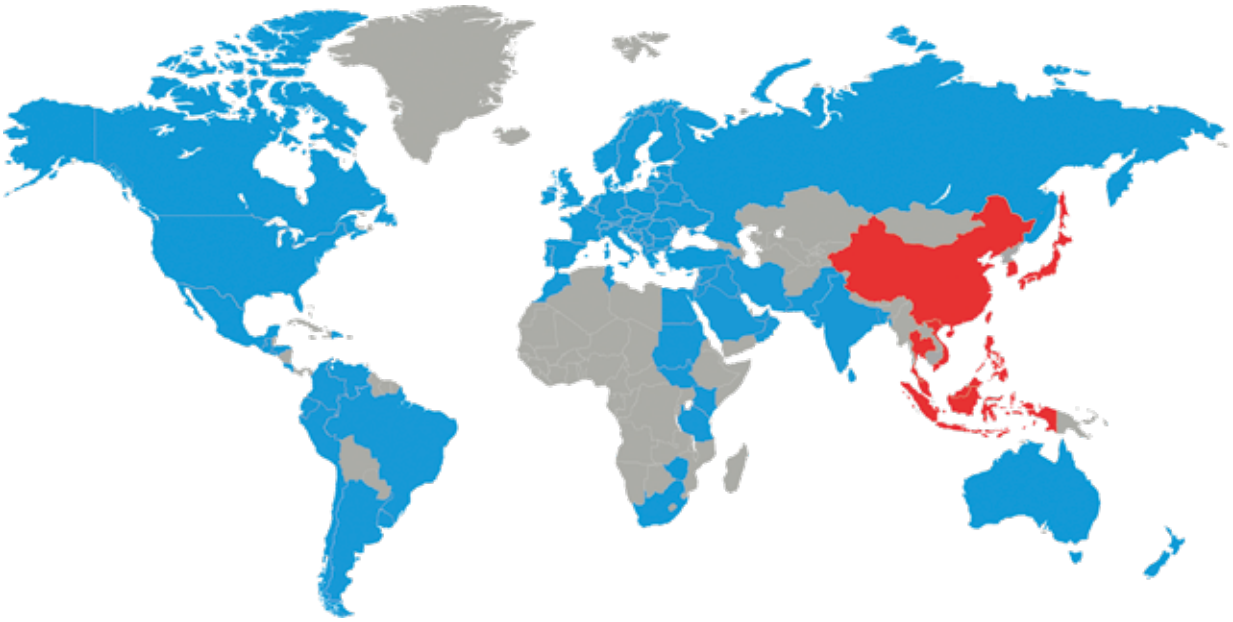
For further information, i.e., steel selection, heat treatment, application and availability, please contact our ASSAB office nearest to you.

RELATIVE COMPARISON OF ASSAB COLD WORK TOOL STEEL

MATERIAL PROPERTIES AND RESISTANCE TO FAILURE MECHANISMS

ASSAB Grade	Hardness/ Resistance to plastic deformation	Machinability	Grindability	Dimension stability	Resistance to		Fatigue cracking resistance	
					Abrasive wear	Adhesive wear/Galling	Ductility/ resistance to chipping	Toughness/ gross cracking
Conventional cold work tool steel								
ASSAB DF-3								
ASSAB XW-10								
ASSAB XW-42								
Calmax								
Caldie (ESR)								
ASSAB 88								
Powder metallurgical tool steel								
Vanadis 4 Extra*								
Vanadis 8*								
Vancron*								
Powder metallurgical high speed steel								
ASSAB PM 23*								
ASSAB PM 30*								
ASSAB PM 60*								
Conventional high speed steel								
ASSAB M2								

* ASSAB PM SuperClean 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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