ASSAB XW-42

ASSAB

ASSAB	UDDEHOLM	REFERENCE STANDARD		
		AISI	DIN	JIS
DF-2	ARNE	O1	1.2510	SKS 3
DF-3		O1	1.2510	SKS 3
XW-5	SVERKER 3	D6 (D3)	(1.2436)	(SKD 2)
XW-10	RIGOR	A2	1.2363	SKD 12
XW-41	SVERKER 21	D2	1.2379	SKD 11
XW-42		D2	1.2379	SKD 11
CARMO	CARMO			
CALMAX	CALMAX			
CALDIE	CALDIE			
ASSAB 88	SLEIPNER			
ASP 23		(M3:2)	1.3344	SKH 53
ASP 30		(M3:2 + Co)	1.3244	SKH 40
ASP 60			1.3241	
VANADIS 4 EXTRA	VANADIS 4 EXTRA			
VANADIS 6	VANADIS 6			
VANADIS 10	VANADIS 10			
VACRON 40	VANCRON 40			
618		P20 Mod.	1.2738	
618 HH		P20 Mod.	1.2738	
618 T		P20 Mod.	1.2738 Mod.	
718 SUPREME	IMPAX SUPREME	P20 Mod.	1.2738	
718 HH	IMPAX HH	P20 Mod.	1.2738	
NIMAX	NIMAX			
UNIMAX	UNIMAX			
CORRAX	CORRAX			
STAVAX ESR	STAVAX ESR	420 Mod.	1.2083 ESR	SUS 420J2
MIRRAX ESR	MIRRAX ESR	420 Mod.		
POLMAX	POLMAX			
ELMAX	ELMAX			
RAMAX LH	RAMAX LH	420 F Mod.		
RAMAX HH	RAMAX HH	420 F Mod.		
ROYALLOY				
PRODAX				
ASSAB PT18				
ASSAB MMXL				
ASSAB MM40				
ALVAR 14	ALVAR 14		1.2714	SKT 4
8407 2M	ORVAR 2M	H13	1.2344	SKD 61
8407 SUPREME	ORVAR SUPREME	H13 Premium	1.2344 ESR	SKD 61
DIEVAR	DIEVAR			
HOTVAR	HOTVAR			
QRO 90 SUPREME	QRO 90 SUPREME			
705		4340	1.6582	SNCM8
709		4140	1.7225	SCM4
760		1050	1.1730	S50C

This information is based on our present state of knowledge and is intended to provide general notes on our products and their uses. It should not therefore be construed as a warranty of specific properties of the products described or a warranty for fitness for a particular purpose.

Edition 090622

General

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	Si	Mn	Cr	Mo	V
	1.55	0.3	0.3	11.6	0.8	0.9
Standard specification	AISI D2, WNr. 1.2379, SKD 11					
Delivery condition	Soft annealed to max. 240 HB					
Colour code	Yellow / White					

Applications

XW-42 is recommended for tools requiring very high wear resistance, combined with moderate toughness (shock resistance). 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.

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 and rings.

BLANKING AND CUTTING

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

FORMING AND OTHER APPLICATIONS

Application	Hardness HRC
Tools for: Bending, forming, deep drawing, rim-rolling, spinning and flow-forming	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 PROPERTIES

Hardened and tempered to hardness 62 HRC.

Temperature	20°C	200°C	400°C
Density kg/m³	7 700	7 650	7 600
Modulus of elasticity MPa	210 000	200 000	–
Coefficient of thermal expansion per °C from 20°C	–	11.7×10^{-6}	12.8×10^{-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	2070	1510
58	2200	1620
60	2950	2150
62	3100	2200

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

Heat treatment

SOFT ANNEALING

Protect the steel and heat through to 850°C. 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, holding time 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 minutes	Hardness before tempering
990	60	63±2 HRC
1010	45	64±2 HRC
1030	30	65±2 HRC

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

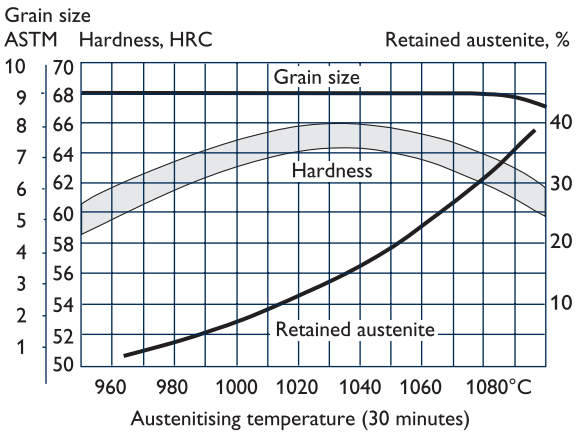
Protect the tool against decarburisation and oxidation during austenitising.

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
- Warm oil, approx. 80°C (only very simple geometries)

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

Hardness, retained austenite and grain size as functions of austenitising 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.

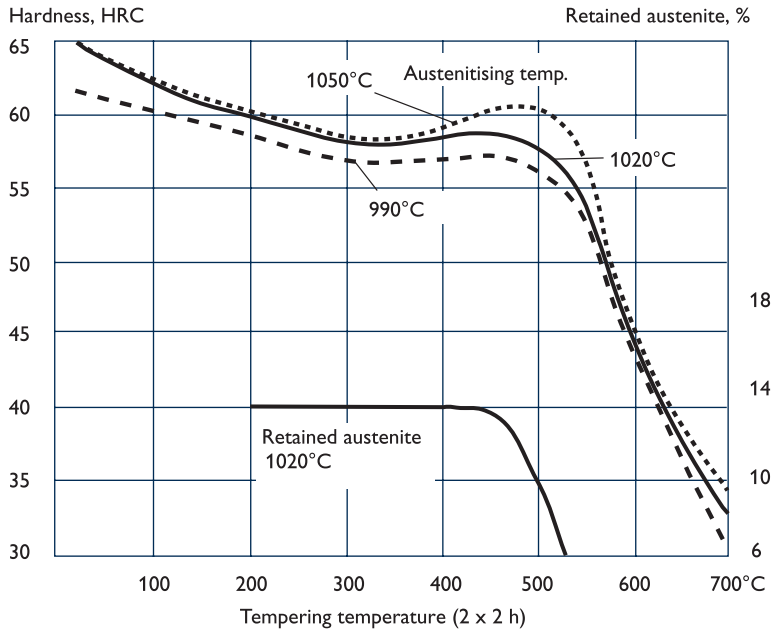
Immediately after quenching, the piece should be sub-zero treated between -120 and -150°C, soaking time 3 - 4 hours, followed by tempering. Sub-zero treatment will give a hardness increase of 1 - 3 HRC.

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 HSS†
	Rough turning	Fine turning	Fine turning
Cutting speed (v_c) m/min	100 - 150	150 - 200	12 - 15
Feed (f) mm/r	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*	–

† *High speed steel*
* *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 HSS 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] *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	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 end mill		
	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 - 0.2[2]	0.08 - 0.2[2]	0.05 - 0.35[2]
Carbide designation ISO	–	K15 - K20[3]	–

[1] *For coated HSS end mill, v_c= 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

Wheel recommendation

Type of grinding	Soft annealed condition	Hardened condition
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 temp.[1]	250°C	250°C
Filler material	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 hours, 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 relieving at 650°C, holding time 2 hours. Cool slowing to 500°C, then freely in air.
3. Semifinish machining
4. Hardening and tempering
5. Finish machining / EDM
6. Nitriding

Process	Time h	Surface hardness $HV_{0.2}$	Depth* mm
Gas nitriding at 510°C	10 30 60	1100 1100 1100	0.11 0.15 0.21
Plasma nitriding at 480°C	10 30 60	1150 1150 1150	0.13 0.17 0.22
Gas nitrocarburising at 580°C	2½	850	0.10

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

Electrical discharge machining

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.

*See back cover page.

Relative comparison of ASSAB cold work tool steels

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	Ductility/ resistance to chipping	Toughness/ gross cracking
DF-3								
CALMAX								
CALDIE (ESR)								
XW-10								
ASSAB 88								
XW-42								
XW-5								
VANADIS 4 EXTRA								
VANADIS 10								
VANCRON 40								
ASP 23								
ASP 30								
ASP 60								
AISI M2								

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* *Sales office with warehouse and/or value added services*

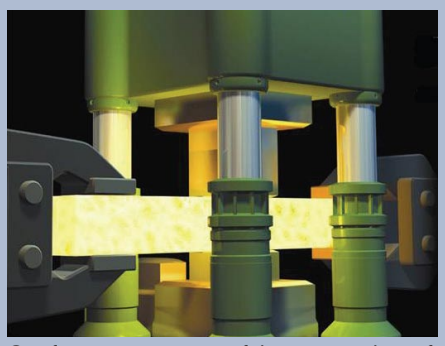
† *Sales office only*

ASSAB TOOL STEELS have been in Asia since 1945. Our customers associate ASSAB brand with tooling materials that are high in quality and consistency.

The ASSAB sales companies and distributors offer you well assorted stocks in a number of places covering the Asia Pacific region. To further shorten the lead time, ASSAB will mill, grind, drill and even wire-cut the tool steel to meet your requirements. ASSAB also provides state-of-the-art vacuum heat treatment services to enhance the steel properties.

Our engineers and metallurgists are always ready to assist you in your choice of the optimum steel grade and the best treament for each application. We always carry out material examinations at our local mini laboratories and at the central laboratory in Sweden.

Our steel mill in Sweden, Uddeholm Tooling, is one of the few steelworks in the world that is dedicated to the manufacture of tool steels only. Uddeholm Tooling is certified to ISO 9001 and ISO 14001.



Our forging press is one of the most modern of its kind in the world.

Besides tool steels, the ASSAB services for tool makers include:

- Welding electrodes for repair welding of tools
- High strength aluminium for tooling purposes
- Copper alloys (e.g., beryllium copper) for inserts in moulds
- Alloy machinery steels
- Cold rolled strip steels for saws, compressor valves, coater blades, etc.
- High Performance Steels (HPS)
- Granshot