



XW-5

UDDEHOLM
SVERKER 3



ASSAB 

		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-5 is a high-carbon, high-chromium tool steel alloyed with tungsten, characterised by:

- Highest wear resistance
- High compressive strength
- High surface hardness after hardening
- Good through-hardening properties
- Good stability during hardening
- Good resistance to tempering-back

XW-5 has gained widespread acceptance as a steel with exceptional wear resistance, suitable for long-life tooling with low repair and maintenance costs, for maximum production economy.

Typical analysis %	C 2.05	Si 0.3	Mn 0.8	Cr 12.7	W 1.1
Standard specification	AISI D6, (AISI D3), (W Nr. 1.2436)				
Delivery condition	Soft annealed to approx. 240 HB				
Colour code	Red				

Applications

XW-5 is recommended for applications demanding maximum wear resistance, such as blanking and shearing tools for thin, hard materials; long-run press tools; forming tools; moulds for ceramics and abrasive plastics.

BLANKING AND CUTTING

Application	Work material thickness	Work material hardness (HB)	
		≤180	>180
<i>Tools for:</i> Blanking, punching, cropping, shearing, trimming, clipping	< 3	60 - 62	56 - 58
Short cold shears for thin materials Shredding knives for plastic waste			56 - 60
Circular shears for light gauge sheet, cardboard etc.			58 - 60
Clipping, trimming tools for forgings			58 - 60
Wood milling cutters, reamers, broachers			56 - 58

FORMING AND OTHER APPLICATIONS

Application	Hardness HRC
<i>Tools for:</i> Bending, raising, deep drawing, rim-rolling, spinning and flow-forming	56 - 62
Tube forming rolls Section forming rolls	58 - 62
Cold drawing / sizing dies	58 - 62
Compacting dies for metal powder parts	58 - 62
Master hobs for cold hobbing	56 - 60
<i>Dies for moulding of:</i> Ceramics, bricks, tiles, grinding wheels, tablets, abrasive plastics	58 - 62
Gauges, measuring tools, guide rails, bushes, sleeves, knurling tools, sandblast nozzles	58 - 62
Crushing hammers	56 - 60
Swaging blocks	56 - 60

Properties

PHYSICAL PROPERTIES

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	194 000	189 000	173 000
Coefficient of thermal expansion per °C from 20°C	—	11.0 × 10 ⁻⁶	10.8 × 10 ⁻⁶
Thermal conductivity W/m °C	20.5	21.5	23
Specific heat J/kg °C	460	—	—

COMPRESSIVE STRENGTH

Approximate compressive yield strength at room temperature.

Hardness HRC	Compressive yield strength R _{C0.2} (MPa)
50	1600
55	1850
60	2100
62	2200

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: 600 - 700°C

Austenitising temperature: 920 - 1000°C, normally 940 - 980°C

Temperature °C	Soaking time minutes	Hardness before tempering
920	60	65±2 HRC
960	30	66±2 HRC
1000	15	66±2 HRC

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

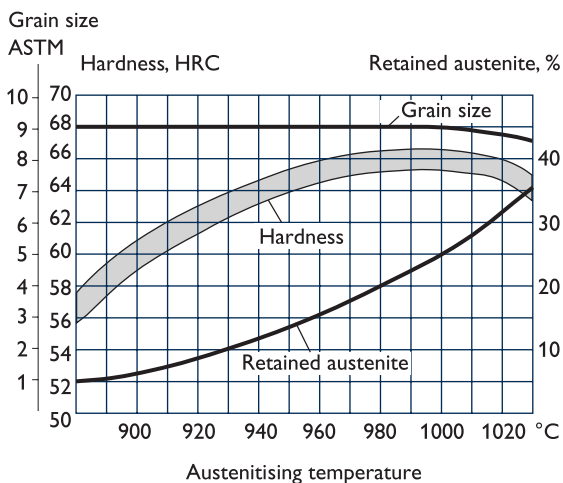
Protect the part against decarburisation and oxidation during hardening.

QUENCHING MEDIA

- Circulating air or atmosphere
- Vacuum (high speed gas with sufficient overpressure)
- Martempering bath or fluidised bed at 180 - 500°C, then cooling in air
- Warm oil, approx. 80°C

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

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

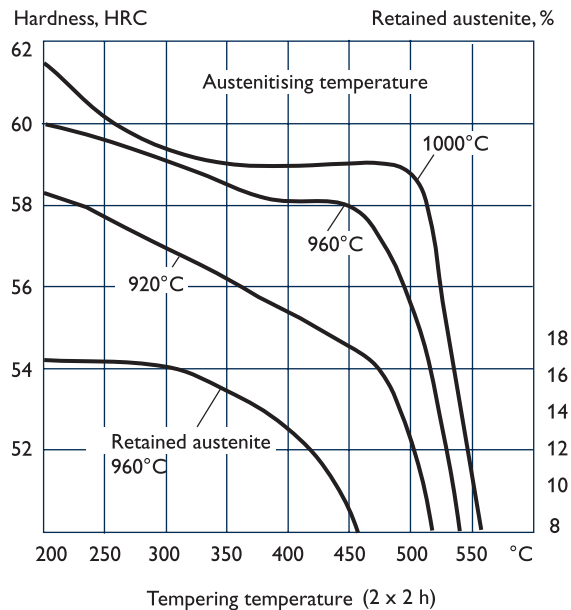


TEMPERING

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



DIMENSIONAL CHANGES

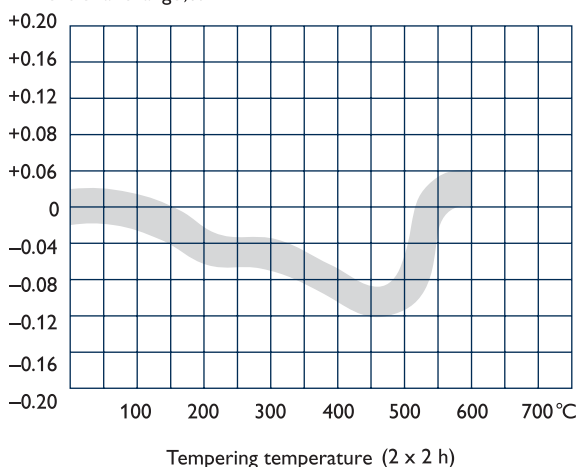
Dimensional changes during hardening

Specimen size: 100 x 100 x 25 mm

Hardening from 960°C		Width %	Length %	Thickness %
Oil hardened	Min. Max.	-0.05 -0.08	+0.07 +0.09	— -0.08
Martempered	Min. Max.	-0.01 -0.03	+0.07 +0.09	— -0.16
Air hardened	Min. Max.	+0.05 +0.06	+0.09 +0.13	— +0.05

Dimensional changes during tempering

Dimensional change, %



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

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, followed by tempering. XW-5 is commonly sub-zero treated between -150°C and -196°C for 3 - 4 hours, although occasionally -40°C and lower temperatures (e.g., -80°C) are used due to constraints of the sub-zero medium and equipment available. Sub-zero treatment will give a hardness increase of 1 - 3 HRC.

Avoid intricate shapes as there is a risk of cracking.

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	200 - 250°C	200 - 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 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 A73G2 53 - 56 HRC UTP A67S 55 - 58 HRC UTP A696 / CastoTIG 5 60 - 64 HRC	Inconel 625 type (buffering layers) 280 HB UTP 67S 55 - 58 HRC Castolin 2 56 - 60 HRC Castolin 6 59 - 61 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.

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 ~240 HB

TURNING

Cutting data parameters	Turning with carbide		Turning with HSS [†] Fine turning
	Rough turning	Fine turning	
Cutting speed (v_c) m/min	70 - 100	100 - 150	8 - 12
Feed (f) mm/r	0.3 - 0.6	≤ 0.3	≤ 0.3
Depth of cut (a_p) mm	2 - 6	0.5 - 2	0.5 - 3
Carbide designation ISO	K20, P10 - P20 Coated carbide*	K15, P10 Coated carbide*	—

[†] 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 - 0.10
5 - 10	10 - 12*	0.10 - 0.20
10 - 15	10 - 12*	0.20 - 0.25
15 - 20	10 - 12*	0.25 - 0.30

* For coated HSS drill, $v_c = 16 - 18$ m/min

Carbide drill

Cutting data parameters	Type of drill		
	Indexable insert	Solid carbide	Brazed carbide ¹
Cutting speed (v_c) m/min	100 - 130	50 - 70	30 - 40
Feed (f) mm/r	0.05 - 0.25 ²	0.10 - 0.25 ²	0.15 - 0.25 ²

¹ Drill with internal cooling channel and 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 - 110	110 - 130
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, P10 - 20 Coated carbide*	K15, P10 Coated carbide*

* 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	30 - 70	40 - 80	10 - 15 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, P10 - P20 Coated carbide ³	—

¹ For coated HSS end mill, $v_c = 20 - 25$ 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	B107 R75 B3 ¹ A 46 HV
Face grinding segments	A 24 GV	3SG 46 FVSPF ¹ A 36 FV
Cylindrical grinding	A 46 LV	B126 R75 B3 ¹ A 60 KV
Internal grinding	A 46 JV	B107 R75 B3 ¹ A 60 IV
Profile grinding	A 100 LV	B107 R100 V ¹ A 100 JV

¹ The first choice is a CBN grinding wheel for this operation

Surface treatment

NITRIDING AND NITROCARBURISING

Nitriding gives a hard surface, which is very resistant to wear and erosion. A nitrided surface also increases the corrosion resistance.

For best results, the following steps should be followed:

1. Rough machining
2. Stress relieving
3. Semifinish machining
4. Hardening and tempering
5. Finish machining / EDM
6. Nitriding

The following surface hardness and nitriding depths will be achieved after nitriding:

Process	Time h	Surface hardness HV _{0.2}	Depth* mm
Gas nitriding at 510°C	10	1000	0.12
	30	1000	0.16
	60	1000	0.18
Plasma nitriding at 480°C	10	1050	0.13
	30	1050	0.16
	60	1050	0.19
Gas nitrocarburising at 580°C	2½	700	0.07

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

Note: The figures refer to hardened and tempered material.

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.

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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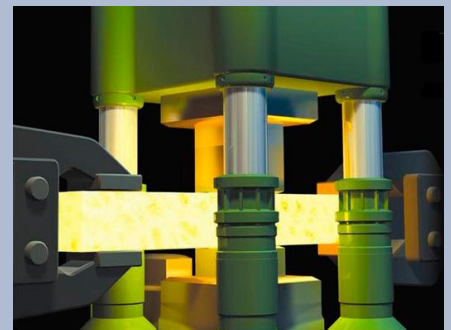
† Sales office only

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 treatment 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