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全球钢号百科!

Global Steel Grade Encyclopedia

涵盖的行业或国家与地区类别

ASTM	GJB	SAE	EU	AISI	DIN	AMS	ISO	JASO
国材料与试验协会	国家军用标准	动力机械工程师协会	前欧洲标准化	美国钢铁学会	德国工业标准	[空航天材料规范	国际标准	日本汽车标准组织
EN	JB	UNS	UNI	ASME	SS	GB	JIS	
欧洲标准	ı国机械行业标准	统一编号系统	意大利标准	美国机械工程师协会	瑞典标准	国家标准	日本工业标准	

GENERAL

ASSAB 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

ASSAB XW-5 has gained widespread acceptance as a steel with exceptional wear resistance, suitable for longlife 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), (WNr. 1.2436)				
Delivery condition	Soft annealed to approx. 240 HB.				
Colour code	Red				

APPLICATIONS

ASSAB 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 HRC	 >180 HRC
Tools for: 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			56 - 60
Wood milling cutters, reamers, broachers			56 - 58

FORMING AND OTHER APPLICATIONS

Application	>180 HRC
Tools for: Bending, raising, deep drawing, rim-rolling, spinning and flow-forming	56 - 62
Tube forming tools, 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
Dies for moulding of: 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
Swinging blocks	56 - 60

PROPERTIES

PHYSICAL PROPERTIES

Hardened and tempered to 62 HRC.

Temperature	20 °C	200 °C	400 °C
Density kg/m³	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 Rc0.2 (MPa)
50	1 600
55	1 850
60	2 100
62	2 200

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

Pre-heating temperature: 600–700°C.
Austenitising temperature: 920–1000°C, normally 940 - 980 °C

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

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

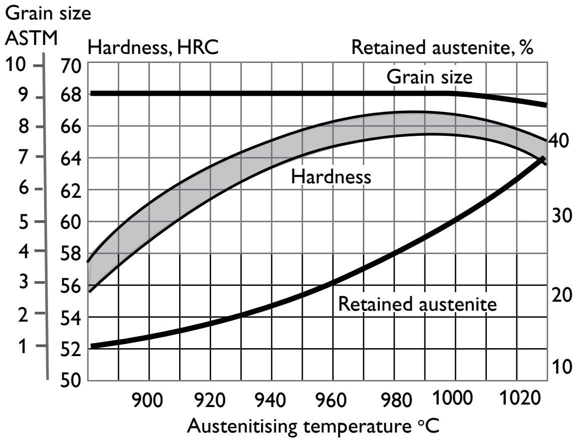
Protect the part against decarburisation and oxidation during hardening.

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

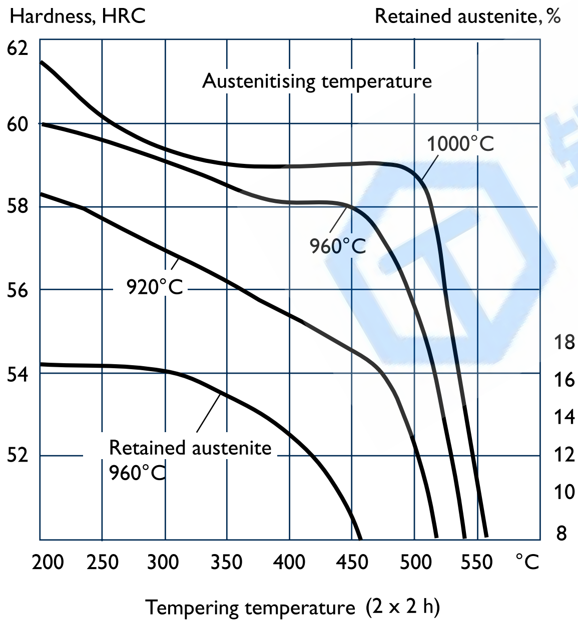


TEMPERING

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



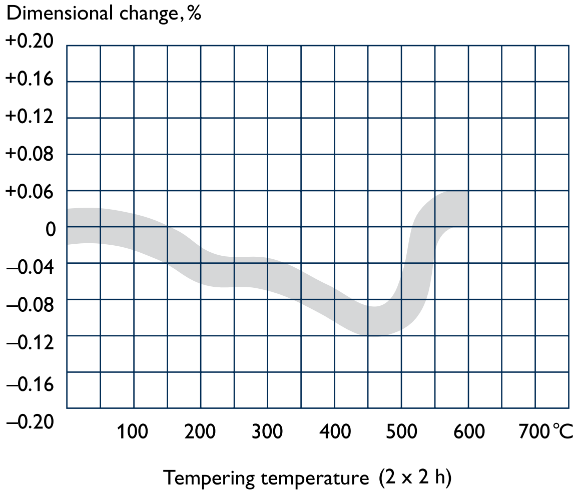
DIMENSIONAL CHANGES

DIMENSIONAL CHANGES DURING HARDENING

Sample plate: 100 x 100 x 25 mm

Hardening from 960°C		Width%	Length %	Thickness %
Oil hardened	min	-0.05	+0.07	0
	max	-0.15	+0.09	-0.08
Martempered	min	-0.01	+0.07	-
	max	-0.03	+0.09	-0.16
Air hardened	min	+0.05	+0.09	-
	max	+0.06	+0.13	+0.05

DIMENSIONAL CHANGES DURING TEMPERING



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. ASSAB 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.

MACHINING RECOMMENDATIONS

The cutting data below are to be considered as guiding values which must be adapted to existing local conditions.

Condition: Soft annealed condition ~240 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	70 – 100	100 – 150	8 - 12
Feed (f) mm/rev	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, P20 - P30 Coated carbide*	K15, P10 Coated carbide*	-

* 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	Carbide tip [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 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 – 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 - P20 Coated carbide*	K15, - P10 Coated carbide*

* 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	30 – 70	40 – 80	10 – 15 [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, P10 – P20 Coated carbide	–

[1] For coated HSS end mill Vc = 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	Hardened
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

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	200 - 250 °C	200 - 250 °C
Filler material	Inconel 625 type (buffering layers) UTP A73G2 UTP A67S UTP A696 CastoTIG 53	Inconel 625 type (buffering layers) UTP 67S Castolin 2 Castolin 6
Maximum interpass temperature	400°C	400°C
Post weld cooling	20 - 40 °C/h the first 2 h then freely in air at <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 	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.

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 tempering at 650°C
3. Grinding
4. Nitriding

Process	Time, h	Surface hardness $HV_{0.2}$	Depth * mm
Gas nitriding at 510°C	10	1 000	0.12
	30	1 000	0.16
	60	1 000	0.18
Plasma nitriding at 480°C	10	1 050	0.13
	30	1 050	0.16
	60	1 050	0.19
Gas nitrocarburising at 580°C	2.5	700	0.07

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

Please contact your local ASSAB office for further information on the selection, heat treatment, application and availability of ASSAB tool steel.

RELATIVE COMPARISON OF ASSAB COLD WORK TOOL STEEL

MATERIAL PROPERTIES AND RESISTANCE TO FAILURE MECHANISMS